

# **RUBY DAM**

## **MANUAL FOR OPERATION AND MAINTENANCE**

**State Water Project Bureau  
Water Resources Division  
Department of Natural Resources and Conservation  
48 North Last Chance Gulch  
P.O. Box 201601  
Helena, MT 59620-1604**

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# TABLE OF CONTENTS

	<u>Page</u>
OVERVIEW .....	1
General Location Map (Figure 1) .....	3
Project Area Map (Figure 2) .....	4
Dam General Layout Map (Figure 3) .....	5
Monitoring Wells Map (Figure 4) .....	6
STATISTICAL INFORMATION .....	7
OPERATING PROCEDURES .....	11
Method and Schedule of Operation .....	11
Safe Drawdown .....	12
Limits of Appurtenances .....	12
Dam Operator .....	13
Storage Determination .....	14
Inflow and Outflow Monitoring .....	15
Weather Monitoring .....	15
Interaction with Other Dams .....	16
Emergency .....	16
INSPECTION AND MONITORING .....	17
Structural Features Inspection .....	17
Riprap Inspection .....	18
Monitoring Wells .....	18
Seepage Monitoring .....	19
MAINTENANCE .....	21
Routine Maintenance .....	21
Annual Maintenance .....	22
Record Keeping .....	23
REFERENCES .....	25
APPENDICES .....	27
A. CONSENT DECREE AND RESERVOIR OPERATING GUIDELINES .....	A1
B. RATING CURVES AND TABLES .....	B1
Table 1. SLOPE/ELEVATION/STORAGE TABLE .....	B2
Table 2. ALTERNATE SLOPE TABLE .....	B6

## TABLE OF CONTENTS (continued)

	<u>Page</u>
Table 3. ACTIVE STORAGE TABLE .....	B9
Table 4. SPILLWAY RATING CURVE AND TABLE .....	B12
C INSPECTION REPORT FORM.....	C1
D. O&M MANUAL DISTRIBUTION LIST.....	D1
E. MONITORING WELL LOGS.....	E1
F. PROJECT DRAWINGS.....	F1

## OVERVIEW

Ruby Dam is located in Madison County about six miles south of Alder on the Upper Ruby Road. The reservoir is fed primarily by the Ruby River which originates in the Snowcrest and Gravelly Ranges, about 30 miles south of the dam (see Figures 1 and 2). Figure 3 provides a general layout of the dam, spillway and outlet works. Figure 4 shows the location of the monitoring wells.

The dam is owned by the Montana Department of Natural Resources and Conservation (DNRC) and is managed by the State Water Projects Bureau (SWPB) of the DNRC. The Ruby River Water Users Association (here in called "association") operates maintains the dam.

The earthfill dam was completed in 1938. Ruby Dam is 111 feet high and 846 feet long. The reservoir stores 36,663 acre-feet at the spillway crest, 37,612 acre-feet at the top of the flashboards, and 56,355 acre-feet and the dam crest.

The dam's outlet works consist of a wet tower with a 72-inch diameter cast iron gate valve upstream from a 72-inch diameter butterfly valve used for flow control. The butterfly valve's control is at the top of the tower while the gate valve is controlled at the bottom of the tower. There is a spring in the left abutment the is piped to the outlet works.

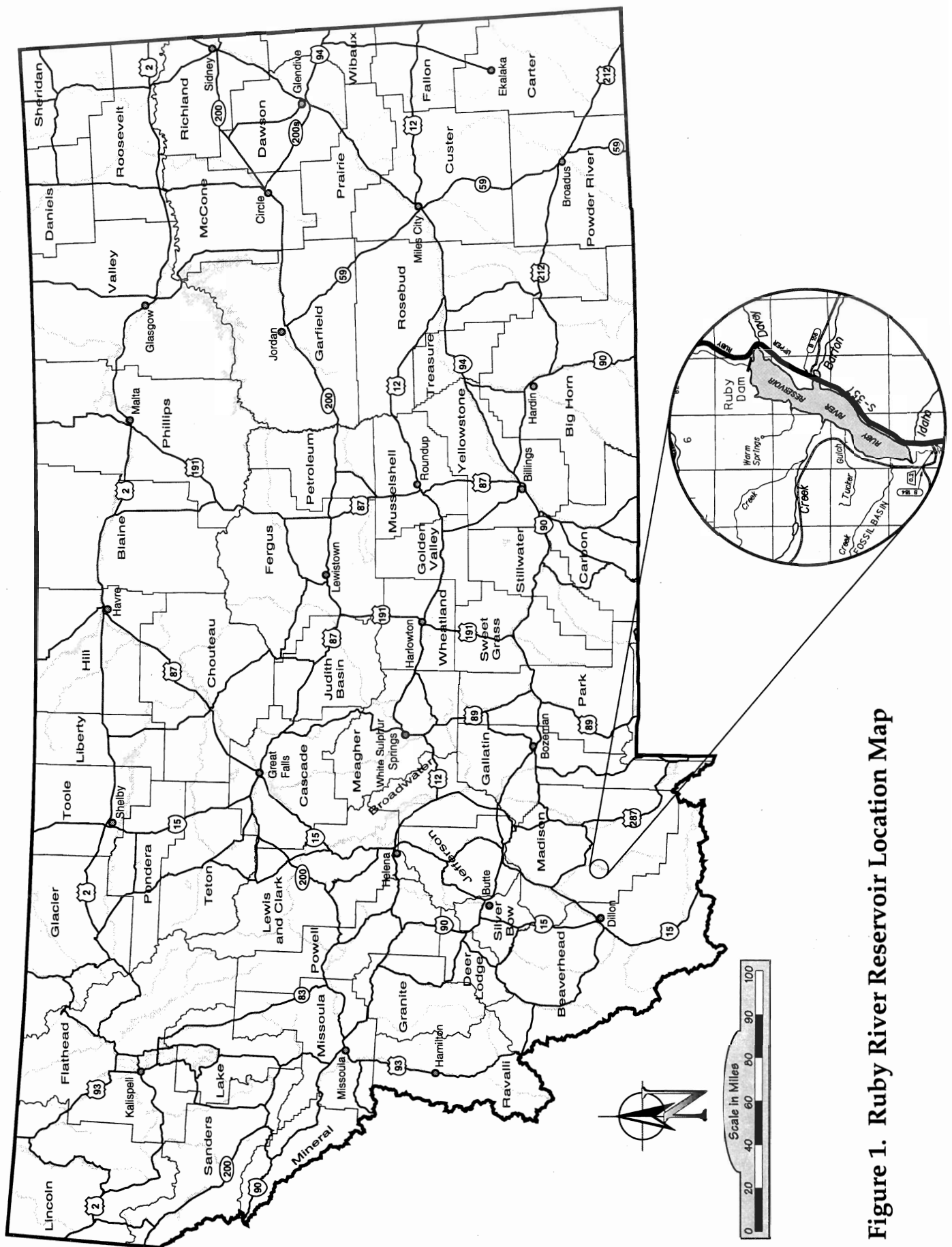
The concrete spillway, located in the right abutment, has an ogee crest. The spillway is 125 feet wide at the top, has flash boards, and tapers to 75 feet at the bottom with a flipbucket for energy dissipation. There is a six inch drain pipe in the middle of the spillway that exits where the flipbucket starts. The spillway

has a capacity of 36,000 cubic feet per second (cfs) without flashboards and 32,400 cfs with the flashboards.

Water from the reservoir is delivered to purchasers through two association-owned canals: the West Bench Canal, 12 miles long with a capacity of 85 cfs, and the Vigilante Canal, 26 miles long with a capacity of 115 cfs.

Water from the reservoir is primarily used for agricultural irrigation. The reservoir is also used for water-based recreation and regulation of stream flows.

At some point on September 1, 1994, the reservoir was completely drained. The river flowing through the reservoir began to erode a channel through the sediment in the bottom of the reservoir and a large amount of sediment was discharged into the river below the reservoir outlet resulting in a large fish kill. A task force was appointed by the Director of the DNRC to develop a minimum reservoir pool size, reservoir operation guidelines, river dewatering prevention plan, and a water delivery plan. In May, 1995, a consent decree was negotiated by DNRC, Department of Environmental Sciences and the association which describes the steps which would be taken to address the water quality violations that occurred when the reservoir was drained. A copy of the Consent Decree and the reservoir operating guidelines adopted by the Ruby River Reservoir Task Force are shown in Appendix A.



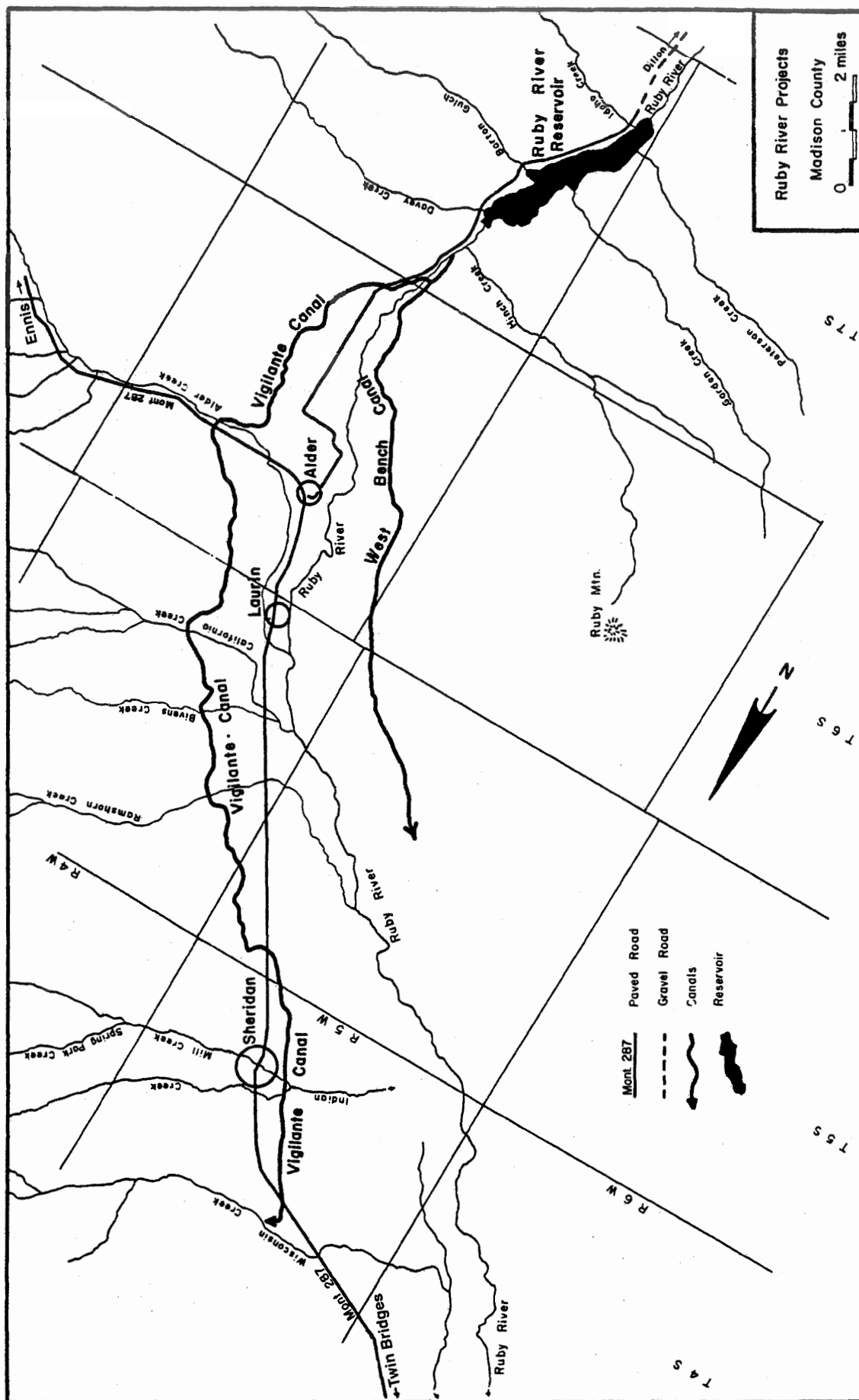


Figure 2. Ruby River Project Map



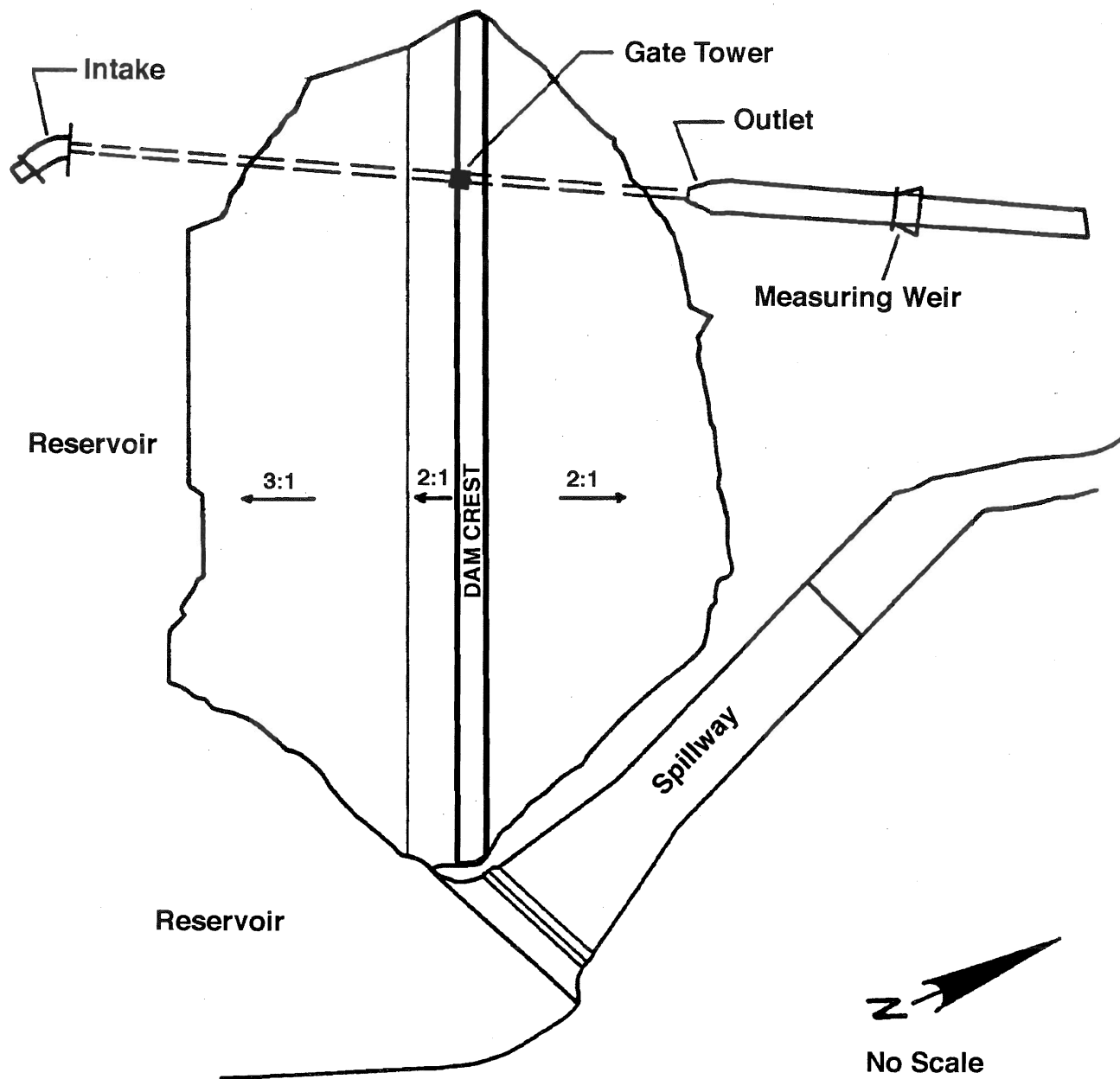


Figure 3. Ruby River Dam General Layout

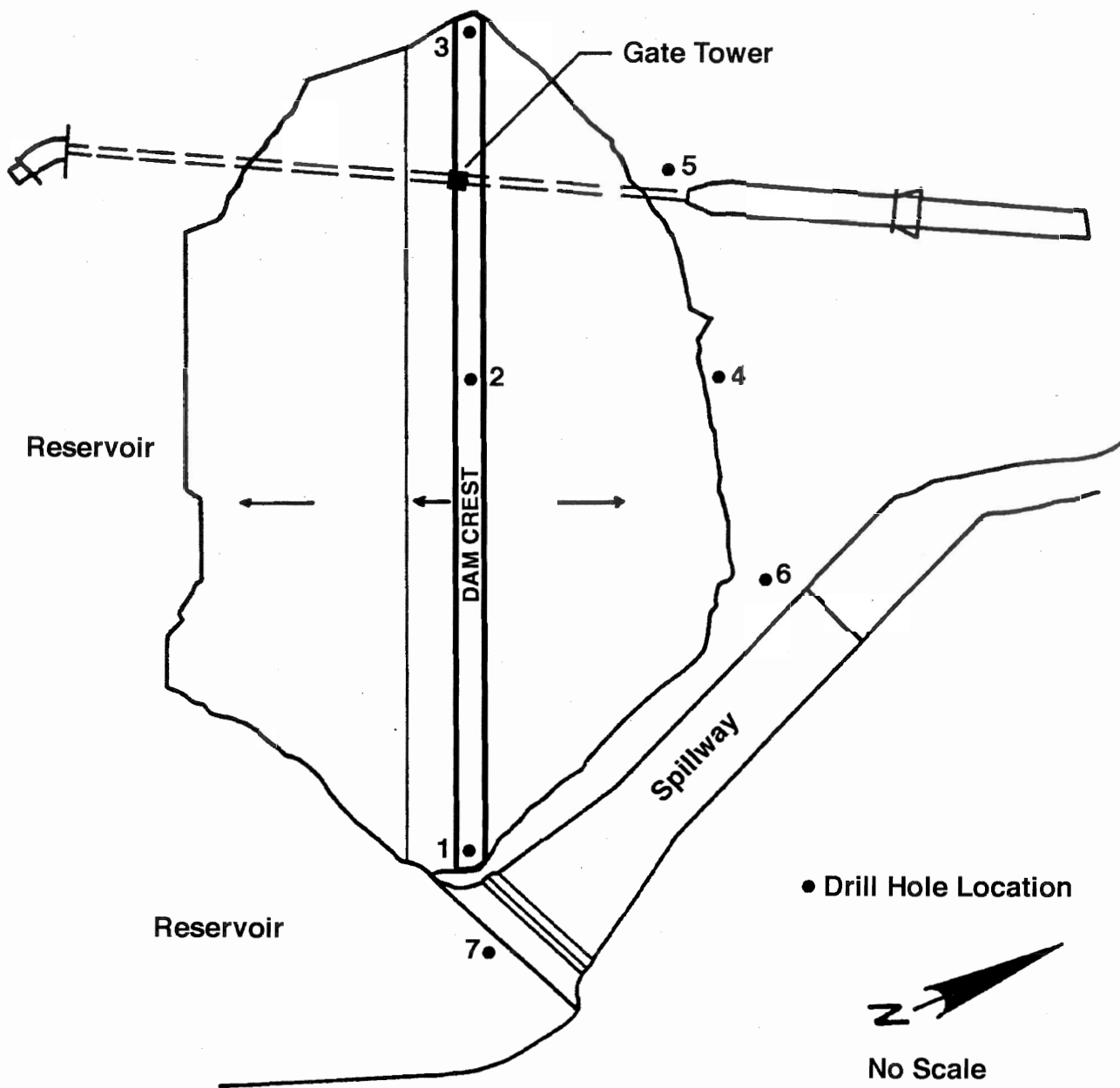


Figure 4. Ruby Dam Monitoring Wells Location

## STATISTICAL INFORMATION

### 1. General

a. Owner	Montana Department of Natural Resources and Conservation (DNRC)
b. Operator	Ruby Water Users Association
c. Location	Section 29, Township 3 South, Range 4 West (dam location)
d. Latitude	45° 14' 06"
Longitude	112° 06' 42"
e. County--State	Madison--Montana
f. Watershed Location	Ruby River, Jefferson River Basin
g. Drainage Area	595 square miles

### 2. Principal Elevations (feet above mean sea level)

a. Minimum Dam Crest	5409.2 feet
b. Normal Full Pool	5,392.97 feet
c. Spillway Crest	5,392.0 feet
d. Spillway Crest (with flashboards)	5,392.97 feet
e. Toe of Dam	5,299.0 feet
f. Outlet Works Intake Invert	5298.0 feet

### 3. Reservoir

a. Length of Maximum Pool (approximate)	3.3 miles
b. Maximum Reservoir Level of Record (May 13, 1984)	5,395.3
c. Surface Area (at normal full pool)	970 acres

#### **4. Storage**

- |  |                  |
|--|------------------|
| a. Maximum Storage<br>(pool at dam crest)                                | 56,355 acre-feet |
| b. Active Storage<br>(pool at flashboard crest)                          | 37,611 acre-feet |
| c. Active Storage<br>(pool at spillway crest)                            | 36,633 acre-feet |
| d. Maximum Surcharge<br>(from spillway flashboard<br>crest to dam crest) | 18,744 acre-feet |

#### **5. Hydrology**

- |  |                                    |
|--|------------------------------------|
| a. Probable Maximum Flood<br>(PMF) (March, 1993)   | 117,200 cfs<br>(470,400 acre-feet) |
| b. 100-year Return Period Flood  | 3,427 cfs                          |
| c. 500-year Return Period Flood  | 5,440 cfs                          |
| d. Maximum flow of record<br>(1938-1992) at USGS<br>Gage 06019500,<br>just upstream from reservoir | 3,810 cfs                          |

#### **6. Embankment (Dam)**

- |  |           |
|--|-----------|
| a. Type                                  | Earthfill |
| b. Hydraulic Height                      | 111 feet  |
| c. Crest Length                          | 846 feet  |
| d. Crest Width                           | 25 feet   |
| e. Downstream Slope                      | 1v on 2h  |
| f. Upstream Slope<br>(above 5392.0 feet) | 1v on 2h  |
| g. Upstream Slope<br>(below 5392.0 feet) | 1v on 3h  |

## **7. Outlet Works**

- |                                    |   |
|------------------------------------|---|
| a. Size                            | 90-inch concrete straight-legged horseshoe  |
| b. Length                          | 635 feet  |
| c. Control                         | 72-inch diameter slide gate (emergency gate) upstream from a 72-inch butterfly valve (operating gate). Both gates are operated from the top of a 96-inch diameter concrete wet tower. |
| d. Capacity<br>(pool at dam crest) | 1,750 cfs   |
| e. Trashrack                       | Yes   |

## **8. Spillway**

- |  |  |
|--|--|
| a. Location  | Right Abutment   |
| b. Type  | Uncontrolled ogee (under normal operation a nominal 1-foot flash board is placed across the crest of the ogee) |
| c. Width   | 125 feet   |
| d. Length  | 361 feet   |
| e. Capacity<br>(pool at spillway crest<br>without flashboards) | 36,000 cfs   |
| (pool at spillway crest<br>with flashboards)                   | 32,400 cfs   |



## **OPERATING PROCEDURE**

The Ruby River Water Users Association operates Ruby Dam and Reservoir to insure safe operation of the project, and to provide an adequate supply of irrigation water to meet contracts with water users without exceeding safe storage or flow levels.

### **METHOD AND SCHEDULE OF OPERATION**

The association's goal is to have the reservoir full before contract holders start putting in calls for water. The reservoir fill almost every year.

The date of irrigation releases varies from year to year, with May 1 typically being the earliest. Irrigation releases from the reservoir usually end by September 30 as specified in the water purchase contracts. The actual dates that releases begin and end depend on a year's actual climatological and hydrological conditions.

Water is also released from the reservoir to help regulate instream flows for fishery purposes. These releases depend on the yearly flow conditions in Ruby River.

The Ruby River Reservoir Task Force adopted a final Reservoir Operating Guidelines in May 1995 which spells out guidelines for the operation of the project to minimize dewatering of the reservoir and the river below the dam. A copy of the guidelines is in Appendix A.

**Maximum Winter Storage:** The maximum reservoir elevation for winter storage is 5,371 feet with 19,294 acre-feet of storage. This winter maximum helps prevent damage to the riprap

and embankment from the wind-driven waves and ice.

**Minimum Winter Storage:** The minimum reservoir elevation for winter storage is 5,330.27 feet with 2,600 acre-feet of storage. The minimum level helps protect the fishery in the reservoir, helps prevent sediment from being washed downstream, and helps prevent ice damage to the inlet structure for the outlet works.

**Minimum Outlet Discharge:** A minimum flow of 800 to 1,200 miner's inches (20 - 30 cfs) must be maintained at the dam outlet.

#### **SAFE DRAWDOWN**

Since the stability of Ruby Dam has not been thoroughly investigated the SWPB recommends that down rate not exceed one foot per day.

#### **LIMITATIONS OF APPURTENANCES**

Appurtenances at Ruby Dam include the spillway, outlet works and delivery canals. The maximum capacity of the outlet works is 1,750 cfs at the minimum dam crest elevation. The flow through the outlet works should be limited to a maximum of 600 cfs for short duration flows, and 450 cfs for long duration flows. These flows are to minimize damage to the outlet stilling basin. In addition the spillway will discharge 36,000 cfs with the reservoir water elevation at the minimum dam crest, without the flashboards in place. The spillway capacity with the flashboards in place is 32,400 cfs. The spillway rating table is shown in Appendix B.



## **DAM OPERATOR**

The responsibility for the daily operation of the dam and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's goal of providing adequate water to satisfy water purchase contract's without exceeding safe storage or flow levels.

The dam operator's specific responsibilities are to:

1. Operate the mechanical features of the outlet works
2. Coordinate filling of the reservoir and the release of water
3. Notify the SWPB of any unusual occurrences such as vandalism, impending floods, structure failure, or excessive seepage.
4. Perform certain maintenance tasks
5. Monitor weather conditions
6. Monitor seepage

Typically, the out-going dam operator, the association, and the SWPB train a new operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage levels, measurement of the rate of water releases, daily observation of unusual conditions, and record-keeping. The outlet gates are operated by a portable electric pipe threading tool, fitted with an adapter to fit the gate operating shaft. If necessary, the gates can be operated manually with a hand crank.

The outlet works are intended to be for controlling the release of irrigation water and not for providing emergency relief.

The dam operator normally is available daily to observe the dam and perform operating functions daily during the filling and irrigation seasons. At other times of the year the dam operator is available weekly or monthly. The dam operator lives downstream of the reservoir, within site of the dam. Any changes to the dam

crest, faces of the dam, or the outlet structure will be visible to the dam operator.

Communication among the dam operator, the association, and the SWPB typically takes place by telephone. During emergencies or unusual occurrences, radio communication may be established so that the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (***see Ruby Dam Emergency Plan***).

### **STORAGE DETERMINATION**

Storage in the reservoir and the elevation of the reservoir surface are determined by taking a slope measurement. Measure in feet from the rebar pin to the water surface. The 0+00 pin is located approximately 50 feet east of the gravel access road to the dam, below the parking lot along the paved highway, and about 8 feet above the eroded bank. The elevation of the reservoir surface and the storage can then be found using the Slope-Elevation-Storage Table in Appendix B.

When the reservoir is at or below 7,500 acre-feet (Elevation 5346.7 feet), the alternate Slope-Elevation-Storage Table in Appendix B should be used. The 0+00 pin is located 48.5 feet on a magnetic heading of 240 degrees from a fiberglass fence post located at the base of the rock outcrop that forms the flat area in front on the spillway. The slope pin alignment is 240 degrees magnetic.

## **INFLOW AND OUTFLOW MONITORING**

Current inflows into the reservoir and outflows from the reservoir can be found under the Upper Missouri River Basin portion of the following USGS internet site:

**[http://montana.usgs.gov/rt-cgi/gen\\_tbl\\_pg](http://montana.usgs.gov/rt-cgi/gen_tbl_pg)**

USGS gage 06019500, Ruby River Above Reservoir, monitors current inflows into the reservoir. The gage is located on the right bank at the county road bridge 0.7 miles downstream of Mormon Creek and 4.2 miles above the reservoir.

USGS gage 06020600, Ruby River Below Reservoir, monitors current outflows from the reservoir. The gage is located on the right bank 0.2 miles downstream of the dam.

## **WEATHER MONITORING**

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service (NWS).

If severe flooding is anticipated, the NWS Great Falls Office **(406-453-2081 or 406-453-4561)** should be contacted for information about the storm, such as the estimated storm intensity and duration, runoff duration (above base flow), and total flood volume of the storm in the Ruby Creek drainage.

Current snow water equivalent and total precipitation can be monitored at three SNOTEL sites located above the reservoir -- Divide, Clover Meadow, and Short Creek. The information for these three sites can be accessed under the Jefferson River Basin portion of the following USDA internet site:

**<ftp://ftp.wcc.nrcs.usda.gov/data/snow/update/mt.txt>**

Additional information about historical snowpack, precipitation, maps and graphs can be accessed at the following internet site:

**<http://www.mt.nrcs.usda.gov/swcs/snow/snow.html>**

### **INTERACTION WITH OTHER DAMS**

Except for irrigation diversion dams, Toston Dam and Canyon Ferry Dam are the next dams downstream from Ruby Dam. The safety of these dams is not affected by the normal operation of Ruby Dam. Therefore, interaction with other dams is not a concern of the normal operation of Ruby Reservoir.

### **EMERGENCY**

If it appears that Ruby Dam about to breach, or during emergency operations, the dam operator should initiate the **Ruby Dam Emergency Action Plan** and notify the operators at Toston Dam (**406-266-3869**) and Canyon Ferry Dam (**406-475-3310, ext 200**) so that they can initiate their Emergency Plans.

## **INSPECTION AND MONITORING**

The SWPB inspects the dam annually. Appendix C includes an example of a SWPB inspection report form. In addition to annual inspections, SWPB personnel will inspect the dam and reservoir during and after heavy runoff and after severe rainstorms and windstorms, during high storage periods, and after an earthquake. The embankment is not monitored by instrumentation.

### **STRUCTURAL FEATURES INSPECTION**

Structural features include the embankment, gatehouse, outlet works, and spillway (Figure 3). The SWPB inspects these structures annually as part of its inspection program. Items to be checked or noted include, but are not limited to:

1. Embankment
  - a. Erosion gullies in dam embankment and dike faces.
  - b. Damage from burrowing animals or vegetation
  - c. Displacement or loss of riprap protection
  - d. Displacement of fill, sink holes, slumps, or other items
  - e. Any seepage on downstream face or base of embankment
2. Gate House -- any damage or vandalism
3. Outlet Works
  - a. Any differential settlement or movement resulting in cracking of the conduit
  - b. Erosion of the seals or concrete by cavitation immediately downstream of the gates
  - c. Major seepage of water into the conduit
  - d. Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
  - e. Operation of both gates through a full cycle

- f. Air vent for free, unobstructed operation
  - g. Corrosion of any metal
  - h. Proper lubrication and cleaning of pedestals for
4. Spillway
- a. Deterioration of concrete
  - b. Separation or movement of joints
  - c. Erosion of the spillway chute, backfill behind the walls, or stilling basin
  - d. Blockage of the approach or exist channel
  - e. Blockage of the drains

#### **RIPRAP INSPECTION**

The riprap along the face of the dam should measure at least 30 inches thick. Immediately after the occurrence of high water, SWPB personnel will inspect the riprap and determine if additional riprap is needed.

#### **MONITORING WELLS**

The dam has seven monitoring wells that were drilled in the fall of 1999. Three monitoring wells are located along the crest of the dam, three along the downstream toe of the dam embankment, and one in the approach channel to the spillway approximately 30 feet upstream of the spillway (see Figure 4). Generally, two piezometers were installed in each monitoring well. Soil profiles of the drill holes and details as to how the wells were constructed are shown in Appendix E.

#### **SEEPAGE MONITORING**

There are no visible downstream seeps below the dam. There are two drains located in the spillway which flow when the

reservoir pool is near the spillway crest. Also, the joints in the two lower right spillway floor slabs seep water when the reservoir pool is near the spillway crest elevation. The weep holes in the spillway flipbucket appear to be flowing, but the rate cannot be determined because the water in the flipbucket submerges the drains.

The 6-inch diameter drain in the left wall of the outlet tunnel flows continually, but the quantity of the flow can not be determined. The drain is difficult to measure due to its location in the outlet tunnel floor. This drain was installed to drain a spring that was discovered during construction of the dam. All of the drains are flowing clear water. To date, no measuring devices have been installed on any of the drains.

The monitoring wells and seepage areas at the dam are observed and monitored by the dam operator, DNRC Bozeman Regional Office, and SWPB during regular visits; and may be measured by the SWPB during annual inspections. The instruments are generally measured twice per month from May 1 to August 31, and once per month in March, April, September, and October. Measurements may be taken during the winter months (November, December, January, February) depending on weather conditions. The monitoring data is maintained by the SWPB in Helena.





## **MAINTENANCE**

The association is responsible for the project's routine maintenance. In addition, the SWPB may identify items that need maintenance or repair during the annual inspection.

### **ROUTINE MAINTENANCE**

To protect the dam and keep it in good working order, the dam operator during regular visits to the dam will watch for and identify any potential maintenance requirements. As soon as a need is identified, the dam operator or association needs to schedule and perform the routine maintenance.

Items that may need occasional attention include, but are not limited to:

1. *Lubrication and cleaning of gate-operating mechanisms.*
2. *Debris or silt restricting the spillway inlet.* Accumulated debris that could affect the spillway operation should be removed at once, with all debris removed at least annually.
3. *Erosion gullies on embankment.* Development of erosion gullies should be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream dam face
4. *Rodent damage.* The rodents will be removed or destroyed and any burrows holes should be filled immediately.
5. *Upstream slope riprap.* Reservoir riprap normally will be observed annually, but may occasionally need repairs due to high water or wave action.
6. *Vegetative cover on downstream slopes.* Good vegetative cover must be maintained, but large brush should be removed.

7. *Noxious weeds.* Noxious weeds on and around the dam embankment and around the reservoir should be sprayed at least on an annual basis.
8. *Clean spillway and outlet structure wall tops.* Spillway and outlet structure wall tops should be clear of any dirt, grass, brush, and any overhanging vegetation or trees.
9. *Repair joints and seal cracks in the spillway and outlet structure.*
10. *Large measuring weir below outlet.* This device will be maintained clean of sediment, algae, free flowing, free of debris, riprap above and below the weir will be maintained. The old pipe measuring device will remain covered.

### **ANNUAL MAINTENANCE**

The SWPB conducts annual inspections of Ruby Dam and reservoir. During these inspections, any items requiring annual maintenance will be identified and recorded. Items that may need annual maintenance include the dam embankment, spillway, outlet works, gates, riprap, roads, large measuring weir, and gatehouse. Other routine items needing immediate attention, such as the need to remove trees or brush, will also be noted.

After the inspection, SWPB sends the association a Dam Safety Inspection Report and a Maintenance Schedule Report. The reports identify items that need maintenance and provide a schedule of when the maintenance tasks need to be completed. The association is responsible for performing the maintenance items with the times specified.

The dam operator or association members may perform the maintenance tasks. However, major repairs will likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

### **RECORD-KEEPING**

The SWPB maintains records, including photographs, of all inspections and maintenance requirements. These records also include seepage monitoring observations. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in downtown Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, monitoring wells, and any unusual conditions. These records may be review at the dam operator's house.



## REFERENCES

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- Ruby River Task Force. June, 1995. Ruby River Reservoir Task Force Final Report.
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# **APPENDICES**





**APPENDIX A**

**CONSENT DECREE**  
**AND**  
**RESERVOIR OPERATING GUIDELINES**

COPY

NANCY SWEENEY  
CLERK-DISTRICT COURT

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DEPUTY

MONTANA FIRST JUDICIAL DISTRICT COURT  
LEWIS AND CLARK COUNTY

STATE OF MONTANA ex rel.  
DEPARTMENT OF HEALTH AND  
ENVIRONMENTAL SCIENCES,

Plaintiff,

v.

STATE OF MONTANA, DEPARTMENT  
OF NATURAL RESOURCES  
AND CONSERVATION and RUBY  
RIVER WATER USERS ASSOCIATION,

Defendants.

Cause No. ADV-95 640

CONSENT DECREE, JUDGMENT, AND ORDER

The Plaintiff, State of Montana ex rel. Department of Health and Environmental Sciences (hereinafter "Plaintiff" or "DHES"), represented by Claudia Massman, Special Assistant Attorney General, and the Defendants, Montana Department of Natural Resources and Conservation, (hereinafter "DNRC"), represented by Donald MacIntyre, Chief Legal Counsel of DNRC,

(CONSENT DECREE, JUDGMENT AND ORDER)

1 and the Ruby River Water Users Association, (hereinafter  
2 "RRWUA"), represented by Russ McElyea of the law firm of  
3 Moore, O'Connell & Refling, have stipulated and agreed to the  
4 entry of the facts and terms within this Consent Decree. The  
5 Court, being otherwise fully informed in the matter, hereby  
6 approves the parties' stipulations and adopts the following  
7 Stipulations as its Findings of Fact and Conclusions of Law  
8 as set forth in this Consent Decree.

9  
10 STIPULATIONS

11 A. Jurisdiction

12 1. The DHES filed a Complaint in this matter on May 25,  
13 1995.

14 2. The parties agree that this Court has jurisdiction  
15 over the subject matter of this action and over the parties  
16 to this action. Defendants acknowledge the requirements of  
17 service are satisfied according to Rule 4D, M.R.Civ.P.

18 B. Objectives

19 3. The DHES, DNRC, and RRWUA wish to resolve this mat-  
20 ter without further litigation and without affecting or im-  
21 pairing any interests, claims, or defenses other than as  
22 explicitly stated herein.

23 4. The resolution stipulated to herein is intended to  
24 ensure that the operation of the Ruby River Reservoir  
25 achieves and maintains compliance with the State's water  
26 quality standards adopted under the authority of the Water  
27

1 Quality Act (Title 75, Chapter 5, Montana Code Annotated  
2 (MCA)).

3 C. Binding Effect

4 5. The provisions of this Consent Decree shall apply to  
5 and be binding upon the DHES, DNRC, RRWUA, and their succes-  
6 sors in interest or assigns.

7 D. General Provisions

8 6. The DHES is the state agency charged with the admin-  
9 istration and enforcement of the Montana Water Quality Act,  
10 Title 75, Chapter 5, MCA, (hereinafter the "Water Quality  
11 Act"), including the authority to enforce water quality stan-  
12 dards adopted pursuant to that Act.

13 7. The Defendant, DNRC, is the state agency charged  
14 with the administration of water development projects, in-  
15 cluding the construction of irrigation and flood projects,  
16 pursuant to Title 85, Chapter 1, part 2, MCA. DNRC con-  
17 structed and owns the Ruby River Reservoir located in Madison  
18 County, Montana, and has acquired the right to store, con-  
19 trol, and divert all unappropriated water of the Ruby River  
20 in Madison County, Montana.

21 8. The Defendant, RRWUA, is a corporation organized and  
22 existing under the laws of Montana and doing business in  
23 Montana. RRWUA is the operator of the Ruby River Reservoir  
24 in Madison County, Montana, pursuant to a contract entered  
25 into between DNRC and RRWUA on March 3, 1937, and amendments  
26 thereto.

1        9. Pursuant to its authority to enforce the State's  
2 Water Quality Act, DHES commenced this action alleging that  
3 the defendants caused pollution of the Ruby River by the  
4 withdrawal of water from Ruby River Reservoir (hereinafter  
5 "Reservoir") in violation of Section 75-5-605(1)(a) of the  
6 Water Quality Act and surface water quality standards adopted  
7 pursuant to that act. In particular, the withdrawal of water  
8 from the Reservoir on September 1, 1994, caused violations of  
9 the turbidity and oxygen standards in Ruby River and resulted  
10 in a fish kill in the river below the dam.

11        10. The DHES alleges that as a result of the drainage  
12 of the Reservoir on or before September 1, 1994, approximate-  
13 ly 3,000 cubic yards of sediment remain deposited in the  
14 first three miles of the Ruby River channel below the dam.  
15 The continued presence of this sediment will likely cause  
16 future violations of the turbidity and oxygen water quality  
17 standards in Ruby River when those sediments are flushed  
18 downstream in spring runoff.

19        11. The parties to this Consent Decree recognize the  
20 need to formally address the violations alleged in the Com-  
21 plaint and ensure that future operations of the Reservoir  
22 will achieve and maintain compliance with the water quality  
23 standards. The Defendants have been actively engaged in the  
24 preparation of a "Reservoir Operations Plan", "Sediment Man-  
25 agement Plan", and resource protection activities to address  
26 this need. Accordingly, the parties agree that it is appro-  
27

1 priate that the Defendants implement the compliance measures,  
2 specifically the Reservoir Operations Plan, the Sediment  
3 Management Plan, and resource protection activities, as fur-  
4 ther described below.

5 E. Compliance Measures

6 12. Upon entry of this Consent Decree, DNRC and RRWUA  
7 agree to submit to the DHES a "Reservoir Operations Plan"  
8 that shall contain the following information:

9 (a) A completed mapping of the Reservoir to estab-  
10 lish its present capacity to determine if there has been  
11 a loss of acre-feet since its original construction in  
12 1938;

13 (b) The establishment of a pool that must be at  
14 least the minimum size necessary to prevent excessive  
15 sediment discharge;

16 (c) Guidance for DNRC and RRWUA staff regarding the  
17 decision-making process for the daily operation of the  
18 dam and its operation in cases of an emergency; and

19 (d) Identify a pool level that will trigger closer  
20 monitoring of the reservoir discharge rates.

21 13. Defendants DNRC and RRWUA further agree to immedi-  
22 ately implement the Ruby River "Sediment Management Plan",  
23 dated March 24, 1995, in accordance with DHES Authorization  
24 No. Mt-40-95, regarding a short-term exemption from surface  
25 water quality standards.

26 14. The parties agree that on receipt of the "Reservoir  
27

Operations Plan" described above (hereinafter "plan"), the DHES shall have fifteen (15) days to review the plan, and may in consultation with the Defendants make changes to the plan that are reasonably necessary to maintain the applicable turbidity and oxygen water quality standards for Ruby River. DNRC and RRWUA agree to implement the plan with the changes that the Department approves as being reasonably necessary to implement the plan.

15. In addition to the requirements specified in paragraphs (12) through (14) above, DNRC and RRWUA agree to perform additional resource protection/conservation activities to enhance the fishery and to maintain an adequate water supply for water users as described in paragraphs (16) through (19) below.

16. In order to enhance the fishery, the Defendants agree to maintain water in the Reservoir significantly above the minimum acre-feet necessary to ensure compliance with water quality standards. The Defendants agree to maintain an absolute minimum level of 2,600 acre-feet at an approximate annual cost estimated to be Three Thousand Seventy-eight Dollars (\$3,078) per year; the net present value of maintaining a reservoir pool in excess of that required to prevent excessive sediment discharge is estimated to be Three Hundred and Sixty-seven Thousand Dollars (\$367,000). DHES agrees a minimum level of 2,600 acre-feet is significantly above the minimum acre-feet necessary to achieve compliance with water

1 quality standards.

2 17. In order to prevent dewatering of the Ruby River  
3 and to benefit the fishery, the RRWUA agrees to maintain a  
4 minimum release from the dam into Ruby River of 20 to 30  
5 cubic feet per second during the months of November through  
6 March of each year. The net present value of the in-stream  
7 flows (approximately 6,000 to 9,000 acre-feet per year) over  
8 a 50-year period is estimated to be \$958,369 to \$1,437,553.

9 18. In order to ensure that adequate flows are main-  
10 tained in Ruby River for irrigation uses and for the support  
11 of the fishery, Defendants agree to install four stream gag-  
12 ing stations during the summer of 1995. The total cost for  
13 installation, operation, and maintenance of these stations is  
14 estimated to be \$83,400.

15 19. In order to ensure adequate delivery of water for  
16 irrigation and to prevent dewatering, the RRWUA agrees to  
17 actively work with the decreed water users to ensure that  
18 measuring devices will be installed where necessary and crit-  
19 ical to ensure delivery of water, to prevent dewatering with-  
20 in the next five years, and to ensure the use of water com-  
21 mensurate with decreed rights. It is anticipated that such  
22 devices will be installed on various ditches at an average  
23 cost of \$2,500 per ditch.

24 20. DNRC and RRWUA further agree to provide to DHES a  
25 brief annual report summarizing implementation of the compli-  
26 ance measures described in paragraphs (12) through (19)

27



1 above.

2 F. Release/Settlement

3 21. (a) In consideration for the actions taken by Defen-  
4 dants under this Consent Decree, the DHES releases and cove-  
5 nants not to bring further actions against Defendants for  
6 violations of water quality alleged in the Complaint and  
7 resulting from the dewatering of the Ruby River Reservoir in  
8 September, 1994. DHES further covenants and agrees not to  
9 pursue further legal action against the Defendants for water  
10 quality violations not raised in the Complaint, but arising  
11 from the dewatering of the Ruby River Reservoir in September,  
12 1994. The releases and covenants provided by DHES in this  
13 paragraph are conditioned upon proper implementation of this  
14 Consent Decree, Judgment and Order by the Defendants. This  
15 covenant not to sue does not limit the DHES' authority either  
16 to enforce this Consent Decree or to enforce otherwise appli-  
17 cable environmental laws and regulations.

18 (b) This Consent Decree constitutes a full settlement  
19 and resolution of Defendants' noncompliance with the Water  
20 Quality Act as alleged in the Department's Complaint dated  
21 May 25, 1995.

22 G. Reservation of Rights

23 22. The DHES reserves its rights to bring an action  
24 against any person, including the defendants, for civil or  
25 criminal penalties or injunctive relief for any violation of  
26 the Water Quality Act that is not specifically addressed by  
27

1 the Complaint in this matter, by this Consent Decree, or  
2 which does not arise from dewatering of the Ruby River Reser-  
3 voir in September, 1994. The DHES also reserves all legal  
4 and equitable remedies available to it to enforce the provi-  
5 sions of this Consent Decree.

6 23. The DHES does not, by its consent to the entry of  
7 this Consent Decree, warrant or aver in any manner that the  
8 Defendants' complete compliance with this Consent Decree will  
9 result in compliance with applicable provisions of the Mon-  
10 tana Water Quality Act or rules implementing that Act. Not-  
11 withstanding the DHES' review and approval of any plans for-  
12 mulated pursuant to this Consent Decree, the Defendants'  
13 shall remain solely responsible for compliance with the terms  
14 of the Act and this Consent Decree.

15 24. The Defendants reserve their rights which they may  
16 have to oppose and defend against any claims brought by the  
17 DHES that are not averred in the Complaint, and to assert any  
18 claims they may have against any person.

19 H. Effective Date

20 25. This Consent Decree is effective upon the date of  
21 execution by this Court.

22 I. Termination

23 26. The Defendants may petition the Court, with service  
24 to the DHES, for termination of this Consent Decree when  
25 Defendants have completed all obligations specified under the  
26 Compliance Terms of this Consent Decree.

27

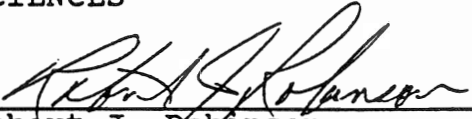
1 J. Authorization

2 27. The undersigned representatives of the Defendants  
3 and the DHES certify that they are authorized by their re-  
4 spective parties to enter into this Consent Decree and to  
5 execute and legally bind that party to the terms and condi-  
6 tions of this Consent Decree.

7 28. The parties hereby agree to the entry of this Con-  
8 sent Decree, Judgment and Order as more fully appears from  
9 their signatures written below.

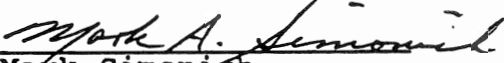
10 MONTANA DEPARTMENT OF  
11 HEALTH AND ENVIRONMENTAL  
12 SCIENCES

13 BY:

  
14 Robert J. Robinson  
Director


MONTANA DEPARTMENT OF  
NATURAL RESOURCES AND  
CONSERVATION

BY:

  
Mark Simonich  
Director

15 MONTANA DEPARTMENT OF  
16 HEALTH AND ENVIRONMENTAL  
SCIENCES

17 BY:

  
18 Claudia L. Massman  
Assistant Attorney General

BY:

RUBY RIVER WATER  
USERS' ASSOCIATION

 Pres.

19  
20 ORDER AND JUDGMENT

21 THIS MATTER having come before the Court upon the par-  
22 ties' request for entry of this Consent Decree, Judgment, and  
23 Order, and the Court having fully reviewed the matter, it is  
24 hereby

25 FOUND that the terms and provisions of this Consent  
26 Decree in their entirety represent a fair, reasonable, and  
27

1 equitable settlement of all matters and it is therefore

2 ORDERED that the foregoing terms and conditions of the  
3 Consent Decree are adopted by the Court and made an Order and  
4 Judgment of this Court.

5 DATED this 30 day of May, 1995.

6  
7 DOROTHY McCARTER  
District Judge

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27 (CONSENT DECREE, JUDGMENT AND ORDER)

# **RUBY RIVER RESERVOIR**

## **OPERATING GUIDELINES**

The Ruby River Reservoir is owned by the Department of Natural Resources and Conservation (DNRC) and operated by the Ruby River Water Users Association (RRWUA). The reservoir is to be operated within the guidelines outlined below.

### **Regulate Outflow**

- Goals:**
- Satisfy contracts.<sup>1</sup>
  - Minimize erosion and downstream flooding.
  - Prevent dewatering of the Ruby River downstream from the reservoir.

- Guidelines:**
1. The maximum sustainable outflow is 18,000 miner's inches (450 cfs). This rate can be exceeded up to a maximum of 24,000 miner's inches (600 cfs) for short periods of time.
  2. A minimum flow of 800 to 1,200 miner's inches (20-30 cfs) must be maintained at the dam outlet.
  3. If there is a demand from decreed water users, the amount of the inflow to the dam shall be allowed to flow out of the reservoir and past the diversion dam.
  4. The RRWUA will work with contract holders, decreed water users and the DNRC to implement the Water Delivery and Dewatering Prevention Plan for the Ruby River.
  5. The RRWUA shall notify the DNRC when flows drop to key points identified in the Water Delivery and Dewatering Prevention Plan. Staff gage readings from the following

---

<sup>1</sup> Peak irrigation demand is typically 20,000 to 25,000 miner's inches (500 to 625 cfs). In mid-July irrigation demands decrease to 12,000 to 15,000 miner's inches (300 to 375 cfs).

bridges will also be reported to the DNRC as noted in the plan: Coy Brown, Alder, Laurin, Silver Springs, Harrington and Phipps.

### **Regulate Reservoir Elevations**

- Goals:**
- Provide stored water to fulfill contracts.
  - Prevent sediment from washing out of the reservoir and adversely affecting water quality downstream by maintaining a minimum pool in the reservoir.

- Guidelines:**
1. By April 1 of each year, the RRWUA and the DNRC shall meet to evaluate reservoir storage, snowpack, streamflow, streamflow forecast, soil moisture and the weather forecast.

If the reservoir elevation is higher than average<sup>2</sup> and indications are that a wet, high runoff spring could exist, the RRWUA and the DNRC will consider increasing the outflow to provide some capacity for flood control and also to postpone the spill so that it coincides with peak irrigation demand.

If the reservoir elevation is lower than average and conditions indicate that a dry, low runoff spring<sup>3</sup> could exist, the RRWUA and DNRC will evaluate alternatives for allocating water to ensure that water is available throughout the irrigation season.

2. The RRWUA will notify the DNRC when the free-flow or natural flow period has ended and the RRWUA begins to satisfy contracts for stored water.
3. If the amount of water in the reservoir drops

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<sup>2</sup> 5,384 feet.

<sup>3</sup> For example, dry conditions existed during the years 1988, 1992 and 1994. Conditions during these years can be used for comparison purposes.

to 7,500 acre-feet, representatives of the RRWUA, the DNRC and the Department of Fish, Wildlife and Parks will meet to discuss future operation of the reservoir and to determine what accommodations need to be made in order to maintain a minimum pool. The DNRC will establish a benchmark at the corresponding elevation.

4. The reservoir storage may not be drawn down below 2,600 acre-feet, which is the absolute minimum pool. The DNRC will establish a benchmark at the corresponding elevation.
5. The RRWUA will report to the DNRC every two weeks on the current reservoir elevation.

### **Emergency Response**

- Goals:**
- Provide maximum early warning in the event of a failure of the Ruby Dam. Minimize loss of life or property.

- Guidelines:**
1. The RRWUA will follow the Emergency Plan for the Ruby Reservoir.

### **Maintenance**

- Goals:**
- Maintain the dam in good condition so that it will continue to fulfill its function of providing a reliable source of irrigation water.
  - Maintain the dam in good condition so as to minimize the risk to life or property downstream of the dam.

- Guidelines:**
1. The RRWUA will operate and maintain the reservoir in accordance with the Ruby River Reservoir Manual for Operation and Maintenance.





**APPENDIX B**

**RATING CURVES AND TABLES**

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE****RUBY RESERVOIR**

Slope pins installed October 13, 2000.

The 0+00 pin is located 8 feet above the eroded bank near the old slope line.

The alignment is slightly west of the old line and a path was cleared through the rocks.

A level was used to the 3+21 point and a GPS was used for the remaining points.

Storage values based on new topographic maps completed in 1994.

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
0	5400.37	45,552		36	5392.05	36,683
1	5400.15	45,292		37	5391.93	36,565
2	5399.93	45,038		38	5391.82	36,459
3	5399.71	44,798		39	5391.71	36,353
4	5399.49	44,558		40	5391.60	36,247
5	5399.27	44,318		41	5391.48	36,131
6	5399.05	44,078		42	5391.36	36,015
7	5398.83	43,839		43	5391.24	35,899
8	5398.64	43,631		44	5391.11	35,774
9	5397.83	42,748		45	5390.99	35,659
10	5397.03	41,875		46	5390.87	35,542
11	5396.23	41,003		47	5390.75	35,426
12	5395.43	40,131		48	5390.63	35,311
13	5395.02	39,683		0+50 CAP	5390.58	35,262
14	5394.87	39,530		49	5390.51	35,195
15	5394.73	39,389		50	5390.40	35,089
16	5394.58	39,237		51	5390.32	35,011
17	5394.43	39,086		52	5390.25	34,944
18	5394.29	38,945		53	5390.17	34,867
19	5394.14	38,793		54	5390.09	34,789
20	5394.01	38,662		55	5390.01	34,712
21	5393.88	38,531		56	5389.93	34,638
22	5393.75	38,399		57	5389.85	34,565
23	5393.62	38,268		58	5389.78	34,501
24	5393.49	38,137		59	5389.70	34,427
25	5393.36	38,006		60	5389.63	34,363
26	5393.23	37,874		61	5389.52	34,262
27	5393.09	37,733		62	5389.41	34,162
28	5392.96	37,602		63	5389.30	34,061
29	5392.83	37,471		64	5389.20	33,969
30	5392.71	37,349		65	5389.09	33,869
31	5392.60	37,238		66	5388.98	33,767
32	5392.49	37,127		67	5388.88	33,676
33	5392.38	37,016		68	5388.77	33,575
34	5392.27	36,905		69	5388.66	33,474
35	5392.16	36,794		70	5388.56	33,382
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)**

**RUBY RESERVOIR**

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
71	5388.50	33,327		114	5384.18	29,415
72	5388.44	33,272		115	5384.01	29,270
73	5388.38	33,217		116	5383.84	29,124
74	5388.32	33,162		117	5383.68	28,987
75	5388.26	33,107		118	5383.51	28,841
76	5388.20	33,052		119	5383.34	28,696
77	5388.14	32,997		120	5383.06	28,456
78	5388.07	32,933		121	5382.87	28,293
79	5388.01	32,878		122	5382.67	28,122
80	5387.96	32,832		123	5382.47	27,950
81	5387.89	32,768		124	5382.28	27,788
82	5387.83	32,713		125	5382.08	27,616
83	5387.77	32,658		126	5381.88	27,445
84	5387.70	32,593		127	5381.68	27,274
85	5387.64	32,538		128	5381.49	27,111
86	5387.57	32,474		129	5381.29	26,940
87	5387.51	32,419		130	5381.10	26,777
88	5387.45	32,364		131	5380.88	26,588
89	5387.38	32,300		132	5380.66	26,400
90	5387.32	32,245		133	5380.44	26,211
91	5387.21	32,144		134	5380.22	26,023
92	5387.10	32,043		135	5380.00	25,835
93	5386.99	31,942		136	5379.78	25,664
94	5386.88	31,842		137	5379.56	25,494
95	5386.77	31,741		138	5379.34	25,324
96	5386.66	31,640		139	5379.12	25,154
97	5386.54	31,530		140	5378.88	24,969
98	5386.43	31,429		141	5378.70	24,830
99	5386.32	31,328		142	5378.48	24,660
100	5386.21	31,227		143	5378.16	24,412
1+00 CAP	5386.20	31,218		144	5377.84	24,165
101	5386.08	31,108		145	5377.52	23,918
102	5385.96	30,998		146	5377.20	23,670
103	5385.83	30,879		147	5376.87	23,415
104	5385.71	30,769		148	5376.46	23,098
105	5385.58	30,649		149	5376.23	22,920
106	5385.46	30,539		150	5376.10	22,820
107	5385.33	30,420		1+50 CAP	5376.10	22,820
108	5385.21	30,310		151	5375.86	22,634
109	5385.08	30,191		152	5375.61	22,441
110	5384.85	29,989		153	5375.37	22,256
111	5384.68	29,843		154	5375.12	22,062
112	5384.51	29,698		155	5374.88	21,889
113	5384.35	29,561				
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)**

**RUBY RESERVOIR**

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
156	5374.63	21,722		203	5365.61	16,045
157	5374.39	21,561		204	5365.46	15,951
158	5374.14	21,394		205	5365.31	15,869
159	5373.90	21,234		206	5365.17	15,786
160	5373.73	21,121		207	5365.02	15,698
161	5373.49	20,959		208	5364.87	15,618
162	5373.26	20,812		209	5364.72	15,540
163	5373.03	20,652		210	5364.57	15,461
164	5372.80	20,498		211	5364.40	15,372
165	5372.56	20,337		212	5364.24	15,288
166	5372.33	20,183		213	5364.07	15,199
167	5372.10	20,029		214	5363.91	15,115
168	5371.86	19,869		215	5363.74	15,026
169	5371.63	19,715		216	5363.58	14,942
170	5371.39	19,554		217	5363.41	14,853
171	5371.19	19,421		218	5363.25	14,770
172	5371.00	19,294		219	5363.08	14,680
173	5370.81	19,166		220	5362.93	14,602
174	5370.62	19,039		221	5362.77	14,518
175	5370.43	18,912		222	5362.61	14,434
180	5369.48	18,314		223	5362.45	14,350
181	5369.30	18,213		224	5362.29	14,267
182	5369.13	18,113		225	5362.13	14,183
183	5368.95	18,008		226	5361.97	14,099
184	5368.77	17,902		227	5361.80	14,010
185	5368.60	17,802		228	5361.64	13,926
186	5368.42	17,696		229	5361.48	13,842
187	5368.24	17,590		230	5361.32	13,758
188	5368.06	17,485		231	5361.18	13,685
189	5367.89	17,385		232	5361.04	13,612
190	5367.71	17,279		233	5360.90	13,538
191	5367.55	17,185		234	5360.76	13,465
192	5367.38	17,085		235	5360.61	13,386
193	5367.21	16,985		236	5360.47	13,313
194	5367.05	16,891		237	5360.33	13,239
195	5366.88	16,791		238	5360.19	13,166
196	5366.72	16,697		239	5360.05	13,093
197	5366.55	16,597		240	5359.92	13,030
198	5366.38	16,497		241	5359.77	12,960
199	5366.22	16,403		242	5359.63	12,896
200	5366.06	16,309		243	5359.48	12,827
2+00 CAP	5366.03	16,292		244	5359.33	12,757
201	5365.91	16,221		245	5359.19	12,693
202	5365.76	16,133				
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 1. SLOPE-ELEVATION-STORAGE TABLE (continued)**

**RUBY RESERVOIR**

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
246	5359.04	12,626		290	5351.10	9,160
247	5358.90	12,559		291	5351.04	9,135
248	5358.75	12,490		292	5350.97	9,110
249	5358.60	12,420		293	5350.91	9,082
250	5358.44	12,346		294	5350.84	9,053
2+50 CAP	5358.40	12,328		295	5350.78	9,028
251	5358.27	12,268		296	5350.72	9,004
252	5358.10	12,190		297	5350.65	8,975
253	5357.93	12,111		298	5350.59	8,946
254	5357.77	12,037		299	5350.52	8,922
256	5357.43	11,880		3+00 CAP	5350.47	8,901
257	5357.26	11,802		300	5350.47	8,901
258	5357.10	11,728		301	5350.41	8,877
259	5356.93	11,649		302	5350.34	8,848
260	5356.78	11,580		303	5350.28	8,823
261	5356.60	11,497		304	5350.22	8,799
262	5356.42	11,414		305	5350.15	8,770
263	5356.24	11,331		306	5350.09	8,745
264	5356.06	11,248		307	5349.97	8,698
265	5355.88	11,165		308	5349.76	8,621
266	5355.70	11,082		309	5349.54	8,540
267	5355.52	10,999		310	5349.32	8,459
268	5355.34	10,915		311	5349.10	8,379
269	5355.16	10,832		312	5348.88	8,298
270	5354.98	10,750		313	5348.82	8,276
271	5354.81	10,681		314	5348.64	8,210
272	5354.64	10,611		315	5348.46	8,144
273	5354.46	10,537		316	5348.29	8,082
274	5354.29	10,467		317	5348.09	8,008
275	5354.12	10,390		318	5347.75	7,884
276	5353.95	10,328		319	5347.42	7,763
277	5353.77	10,254		320	5347.08	7,638
278	5353.60	10,184		3+21 CAP	5346.70	7,500
279	5353.43	10,115		321	5346.69	7,495
280	5353.27	10,049		322	5346.33	7,363
281	5353.18	10,012		323	5345.96	7,227
282	5352.91	9,902		324	5345.59	7,092
283	5352.65	9,795		325	5345.10	6,912
284	5352.39	9,688		326	5344.59	6,741
285	5352.13	9,582		327	5343.54	6,698
286	5351.86	9,471		328	5343.03	6,231
287	5351.37	9,270		329	5342.53	6,068
288	5351.26	9,225				
289	5351.16	9,184				
DIST	ELEV	STOR		DIST	ELEV	STOR

**TABLE 2. SLOPE-ELEVATION-STORAGE (ALTERNATE) TABLE****RUBY RESERVOIR**

This table is for use when the reservoir is at or below 7,500 AF (Elevation 5346.70).

Slope pins installed September 20, 2000.

The 0+00 pin is located 48.5 ft on a magnetic heading of 240 degrees from a fiberglass fence post driven in at the base of the rock outcrop that forms the flat area in front of the spillway.

The slope pin alignment is 240 degrees magnetic

Storage values based on new topographic maps completed in 1994.

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
A0+00 CAP	5346.70	7,499		35	5343.16	6,274
1	5346.62	7,469		36	5343.04	6,235
2	5346.54	7,440		37	5342.91	6,192
3	5346.47	7,414		38	5342.79	6,153
4	5346.39	7,385		39	5342.66	6,110
5	5346.31	7,356		40	5342.55	6,074
6	5346.23	7,326		41	5342.44	6,038
7	5346.15	7,297		42	5342.33	6,002
8	5346.08	7,271		43	5342.22	5,966
9	5346.00	7,242		44	5342.11	5,931
10	5345.93	7,216		45	5342.00	5,895
11	5345.84	7,183		46	5341.89	5,859
12	5345.75	7,150		47	5341.78	5,823
13	5345.66	7,118		48	5341.67	5,787
14	5345.57	7,085		49	5341.56	5,751
15	5345.49	7,055		A0+50 CAP	5341.45	5,715
16	5345.40	7,022		51	5341.36	5,685
17	5345.31	6,989		52	5341.27	5,656
18	5345.22	6,956		53	5341.17	5,623
19	5345.13	6,923		54	5341.08	5,594
20	5345.01	6,879		55	5340.99	5,564
21	5344.89	6,840		56	5340.90	5,535
22	5344.76	6,797		57	5340.80	5,502
23	5344.64	6,758		58	5340.71	5,473
24	5344.51	6,715		59	5340.62	5,443
25	5344.39	6,676		60	5340.56	5,424
26	5344.26	6,634		61	5340.48	5,398
27	5344.14	6,594		62	5340.39	5,368
28	5344.01	6,552		63	5340.31	5,342
29	5343.89	6,513		64	5340.22	5,312
30	5343.79	6,480		65	5340.14	5,286
31	5343.66	6,437		66	5340.05	5,257
32	5343.54	6,398		67	5339.97	5,232
33	5343.41	6,356		68	5339.89	5,209
34	5343.29	6,316		69	5339.80	5,183
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 2. SLOPE-ELEVATION-STORAGE (ALTERNATE) TABLE**

**RUBY RESERVOIR**

DISTANCE feet	ELEVATION feet	STORAGE acre-feet		DISTANCE feet	ELEVATION feet	STORAGE acre-feet
70	5339.69	5,151		113	5336.51	4,230
71	5339.61	5,128		114	5336.40	4,198
72	5339.52	5,102		115	5336.28	4,163
73	5339.44	5,078		116	5336.17	4,131
74	5339.36	5,055		117	5336.06	4,100
75	5339.27	5,029		118	5335.95	4,068
76	5339.19	5,006		119	5335.83	4,033
77	5339.11	4,983		120	5335.72	4,001
78	5339.02	4,957		121	5335.64	3,978
79	5338.94	4,934		122	5335.55	3,952
80	5338.87	4,913		123	5335.47	3,929
81	5338.81	4,896		124	5335.39	3,905
82	5338.75	4,879		125	5335.31	3,882
83	5338.69	4,861		126	5335.22	3,856
84	5338.63	4,844		127	5335.14	3,833
85	5338.57	4,826		128	5335.06	3,810
86	5338.51	4,809		129	5334.97	3,785
87	5338.45	4,792		130	5334.89	3,765
88	5338.39	4,774		131	5334.81	3,745
89	5338.33	4,757		132	5334.74	3,727
90	5338.28	4,742		133	5334.66	3,707
91	5338.23	4,728		134	5334.59	3,689
92	5338.18	4,713		135	5334.51	3,669
93	5338.14	4,702		136	5334.44	3,652
94	5338.09	4,687		137	5334.36	3,632
95	5338.04	4,673		138	5334.29	3,614
96	5337.99	4,658		139	5334.21	3,594
97	5337.94	4,644		140	5334.14	3,576
98	5337.89	4,629		141	5334.06	3,556
99	5337.85	4,618		142	5333.98	3,536
A1+00 CAP	5337.80	4,603		143	5333.91	3,518
101	5337.70	4,574		144	5333.83	3,498
102	5337.61	4,548		145	5333.75	3,478
103	5337.51	4,519		146	5333.67	3,458
104	5337.42	4,493		147	5333.59	3,438
105	5337.32	4,464		148	5333.52	3,420
106	5337.23	4,438		149	5333.44	3,400
107	5337.13	4,409		A1+50 CAP	5333.37	3,382
108	5337.04	4,383		151	5333.27	3,357
109	5336.94	4,354		152	5333.17	3,332
110	5336.85	4,328		153	5333.08	3,309
111	5336.74	4,296		154	5332.93	3,272
112	5336.62	4,262		155	5332.82	3,244
DISTANCE	ELEVATION	STORAGE		DISTANCE	ELEVATION	STORAGE

**TABLE 2. SLOPE-ELEVATION-STORAGE (ALTERNATE) TABLE**

## RUBY RESERVOIR

[illegible]



**TABLE 3. TOTAL STORAGE IN ACRE-FEET****RUBY RESERVOIR**

<b>Elevation</b>	<b>0.0</b>	<b>0.1</b>	<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>0.5</b>	<b>0.6</b>	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>
<b>5301</b>	0	0	0	0	0	0	1	1	1	1
<b>5302</b>	1	1	1	1	1	1	1	1	1	1
<b>5303</b>	1	1	1	2	2	2	2	2	2	2
<b>5304</b>	2	2	2	2	2	2	2	2	2	2
<b>5305</b>	3	4	5	6	7	8	9	10	11	12
<b>5306</b>	13	14	15	16	17	18	20	21	22	23
<b>5307</b>	24	25	26	27	28	29	30	31	32	33
<b>5308</b>	34	35	36	38	39	40	41	42	43	44
<b>5309</b>	45	46	47	48	49	50	51	52	53	54
<b>5310</b>	56	60	65	70	74	79	83	88	93	97
<b>5311</b>	102	107	111	116	120	125	130	134	139	143
<b>5312</b>	148	153	157	162	166	171	176	180	185	189
<b>5313</b>	194	199	203	208	212	217	222	226	231	235
<b>5314</b>	240	245	249	254	258	263	268	272	277	281
<b>5315</b>	286	295	305	315	325	335	345	355	364	674
<b>5316</b>	384	394	404	414	424	433	443	453	463	473
<b>5317</b>	483	493	502	512	522	532	542	552	562	571
<b>5318</b>	581	591	601	611	621	631	641	650	660	670
<b>5319</b>	680	690	700	710	719	729	739	749	759	769
<b>5320</b>	779	793	808	823	838	853	868	883	897	912
<b>5321</b>	927	942	957	972	987	1,001	1,016	1,031	1,046	1,061
<b>5322</b>	1,076	1,091	1,105	1,120	1,135	1,150	1,165	1,180	1,195	1,209
<b>5323</b>	1,224	1,239	1,254	1,269	1,284	1,299	1,314	1,328	1,343	1,358
<b>5324</b>	1,373	1,388	1,403	1,418	1,432	1,447	1,462	1,477	1,492	1,507
<b>5325</b>	1,522	1,542	1,562	1,582	1,603	1,623	1,643	1,663	1,684	1,704
<b>5326</b>	1,724	1,744	1,765	1,785	1,805	1,825	1,846	1,866	1,886	1,906
<b>5327</b>	1,927	1,947	1,967	1,988	2,008	2,028	2,048	2,069	2,089	2,109
<b>5328</b>	2,129	2,150	2,170	2,190	2,210	2,231	2,251	2,271	2,291	2,312
<b>5329</b>	2,332	2,352	2,372	2,393	2,413	2,433	2,454	2,474	2,494	2,514
<b>5330</b>	2,535	2,560	2,585	2,610	2,635	2,660	2,686	2,711	2,736	2,761
<b>5331</b>	2,786	2,811	2,836	2,862	2,887	2,912	2,937	2,962	2,987	3,013
<b>5332</b>	3,038	3,063	3,088	3,113	3,138	3,164	3,189	3,214	3,239	3,264
<b>5333</b>	3,289	3,315	3,340	3,365	3,390	3,415	3,440	3,465	3,491	3,516
<b>5334</b>	3,541	3,566	3,591	3,616	3,642	3,667	3,692	3,717	3,742	3,767
<b>5335</b>	3,793	3,822	3,850	3,879	3,908	3,937	3,966	3,995	4,024	4,053
<b>5336</b>	4,082	4,111	4,140	4,169	4,198	4,227	4,256	4,285	4,314	4,343
<b>5337</b>	4,372	4,401	4,430	4,459	4,488	4,517	4,546	4,574	4,603	4,632
<b>5338</b>	4,661	4,690	4,719	4,748	4,777	4,806	4,835	4,864	4,893	4,922
<b>5339</b>	4,951	4,980	5,009	5,038	5,067	5,096	5,125	5,154	5,183	5,212
<b>5340</b>	5,241	5,273	5,306	5,339	5,371	5,404	5,437	5,469	5,502	5,535

**TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)****RUBY RESERVOIR**

<b>Elevation</b>	<b>0.0</b>	<b>0.1</b>	<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>0.5</b>	<b>0.6</b>	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>
<b>5341</b>	5,568	5,600	5,633	5,666	5,698	5,731	5,764	5,796	5,829	5,862
<b>5342</b>	5,895	5,927	5,960	5,993	6,025	6,058	6,091	6,123	6,156	6,189
<b>5343</b>	6,222	6,254	6,287	6,320	6,352	6,385	6,418	6,450	6,483	6,516
<b>5344</b>	6,549	6,581	6,614	6,647	6,679	6,712	6,745	6,777	6,810	6,843
<b>5345</b>	6,876	6,912	6,949	6,986	7,022	7,059	7,096	7,132	7,169	7,205
<b>5346</b>	7,242	7,279	7,315	7,352	7,389	7,425	7,462	7,499	7,535	7,572
<b>5347</b>	7,609	7,645	7,682	7,719	7,755	7,792	7,829	7,865	7,902	7,939
<b>5348</b>	7,975	8,012	8,049	8,085	8,122	8,159	8,195	8,232	8,269	9,305
<b>5349</b>	8,342	8,379	8,415	8,452	8,489	8,525	8,562	8,599	8,635	8,672
<b>5350</b>	8,709	8,750	8,791	8,832	8,873	8,914	8,955	8,996	9,037	9,078
<b>5351</b>	9,119	9,160	9,201	9,242	9,283	9,324	9,365	9,406	9,447	9,488
<b>5352</b>	9,529	9,570	9,611	9,652	9,693	9,734	9,775	9,816	9,857	9,898
<b>5353</b>	9,939	9,980	10,021	10,062	10,103	10,144	10,185	10,226	10,267	10,308
<b>5354</b>	10,349	10,390	10,431	10,472	10,513	10,554	10,595	10,636	10,677	10,718
<b>5355</b>	10,759	10,805	10,851	10,897	10,943	10,989	11,036	11,082	11,128	11,174
<b>5356</b>	11,220	11,266	11,312	11,359	11,405	11,451	11,497	11,543	11,589	11,636
<b>5357</b>	11,682	11,728	11,774	11,820	11,866	11,913	11,959	12,005	12,051	12,097
<b>5358</b>	12,143	12,190	12,236	12,282	12,328	12,374	12,420	12,466	12,513	12,559
<b>5359</b>	12,605	12,651	12,697	12,743	12,790	12,836	12,882	12,928	12,974	13,020
<b>5360</b>	13,067	13,119	13,171	13,224	13,276	13,329	13,381	13,433	13,486	13,538
<b>5361</b>	13,591	13,643	13,695	13,748	13,800	13,853	13,905	13,957	14,010	14,062
<b>5362</b>	14,115	14,167	14,219	14,272	14,324	14,377	14,429	14,481	14,534	14,586
<b>5363</b>	14,639	14,691	14,743	14,796	14,848	14,901	14,953	15,005	15,058	15,110
<b>5364</b>	15,163	15,215	15,267	15,320	15,372	15,425	15,477	15,529	15,582	15,634
<b>5365</b>	15,687	15,745	15,804	15,863	15,922	15,980	16,039	16,098	16,157	16,215
<b>5366</b>	16,274	16,333	16,392	16,450	16,509	16,568	16,627	16,685	16,744	16,803
<b>5367</b>	16,862	16,921	16,979	17,038	17,097	17,156	17,214	17,273	17,332	17,391
<b>5368</b>	17,449	17,508	17,567	17,626	17,684	17,743	17,802	17,861	17,919	17,978
<b>5369</b>	18,037	18,096	18,154	18,213	18,272	18,331	18,390	18,448	18,507	18,566
<b>5370</b>	18,625	18,691	18,758	18,825	18,892	18,959	19,026	19,093	19,160	19,227
<b>5371</b>	19,294	19,360	19,427	19,494	19,561	19,628	19,695	19,762	19,829	19,896
<b>5372</b>	19,963	20,029	20,096	20,163	20,230	20,297	20,364	50,431	20,498	20,565
<b>5373</b>	20,632	20,698	20,765	20,832	20,899	20,966	21,033	21,100	21,167	21,234
<b>5374</b>	21,301	21,367	61,434	21,501	21,568	21,635	21,702	21,769	21,836	21,903
<b>5375</b>	21,970	22,047	22,124	22,201	22,279	22,356	22,433	22,511	22,588	22,665

**TABLE 3. TOTAL STORAGE IN ACRE-FEET (continued)****RUBY RESERVOIR**

<b>Elevation</b>	<b>0.0</b>	<b>0.1</b>	<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>0.5</b>	<b>0.6</b>	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>
<b>5376</b>	22,743	22,820	22,897	22,974	23,052	23,129	23,206	23,284	23,361	23,438
<b>5377</b>	23,516	23,593	23,670	23,747	23,825	23,902	23,979	24,057	24,134	24,211
<b>5378</b>	24,289	24,366	24,443	24,520	24,598	24,675	24,752	24,830	24,907	24,984
<b>5379</b>	25,062	25,139	25,216	25,293	25,371	25,448	25,525	25,603	25,680	25,757
<b>5380</b>	25,835	25,920	26,006	26,092	26,177	26,263	26,349	26,434	26,520	26,605
<b>5381</b>	26,691	26,777	26,862	26,948	27,034	27,119	27,205	27,291	27,376	27,462
<b>5382</b>	27,548	27,633	27,719	27,805	27,890	27,976	28,062	28,147	28,233	28,319
<b>5383</b>	28,404	28,490	28,576	28,661	28,747	28,833	28,918	29,004	29,090	29,175
<b>5384</b>	29,261	29,347	29,432	29,518	29,604	29,689	29,775	29,861	29,946	30,032
<b>5385</b>	30,118	30,209	30,301	30,393	30,484	30,576	30,668	30,759	30,851	30,943
<b>5386</b>	31,035	31,126	31,218	31,310	31,401	31,493	31,585	31,676	31,768	31,860
<b>5387</b>	31,952	32,043	32,135	32,227	32,318	32,410	32,502	32,593	32,685	32,777
<b>5388</b>	32,869	32,960	33,052	33,144	33,235	33,327	33,419	33,510	33,602	33,694
<b>5389</b>	33,786	33,877	33,969	34,061	34,152	34,244	34,336	34,427	34,519	34,611
<b>5390</b>	34,703	34,799	34,896	34,992	35,089	35,185	35,282	35,378	35,475	35,571
<b>5391</b>	35,668	35,764	35,861	35,957	36,054	36,150	36,247	36,343	36,440	36,536
<b>5392</b>	36,633	36,734	36,834	36,935	37,036	37,137	37,238	37,339	37,440	37,541
<b>5393</b>	37,642	37,743	37,844	37,945	38,046	38,147	38,248	38,349	38,450	38,551
<b>5394</b>	38,652	38,753	38,854	38,955	39,056	39,157	39,258	39,359	39,460	39,561
<b>5395</b>	39,662	39,771	39,880	39,989	40,098	40,207	40,316	40,425	40,534	40,643
<b>5396</b>	40,752	40,861	40,970	41,079	41,188	41,297	41,407	41,516	41,625	41,734
<b>5397</b>	41,843	41,952	42,061	42,170	42,279	42,388	42,497	42,606	42,715	42,824
<b>5398</b>	42,933	43,042	43,151	43,261	43,370	43,479	43,588	43,697	43,806	43,915
<b>5399</b>	44,024	44,133	44,242	44,351	44,460	44,569	44,678	44,787	44,896	45,005
<b>5400</b>	45,115	45,233	45,351	45,469	45,587	45,705	45,824	45,942	46,060	46,178
<b>5401</b>	46,296	46,414	46,532	46,651	46,869	46,887	47,005	47,123	47,241	47,360
<b>5402</b>	47,478	47,596	47,714	47,832	47,950	48,069	48,187	48,305	48,423	48,541
<b>5403</b>	48,659	48,778	48,896	49,014	49,132	49,250	49,368	49,486	49,605	49,723
<b>5404</b>	49,841	49,959	50,077	50,195	50,314	50,432	50,550	50,668	50,786	50,904
<b>5405</b>	51,023	51,150	51,276	51,403	51,530	51,657	61,784	51,911	52,038	52,165
<b>5406</b>	52,292	52,419	52,546	52,673	52,800	52,927	53,054	53,181	53,308	53,435
<b>5407</b>	53,562	53,689	53,816	53,943	54,070	54,197	54,324	54,450	54,577	54,704
<b>5408</b>	54,831	54,958	55,085	55,212	55,339	55,466	55,593	55,720	55,847	55,974
<b>5409</b>	56,101	56,228	56,355	56,482	56,609	56,736	56,863	56,990	57,117	57,244
<b>5410</b>										

Note: Storage volumes based upon new topographic surveys and maps completed in 1994.

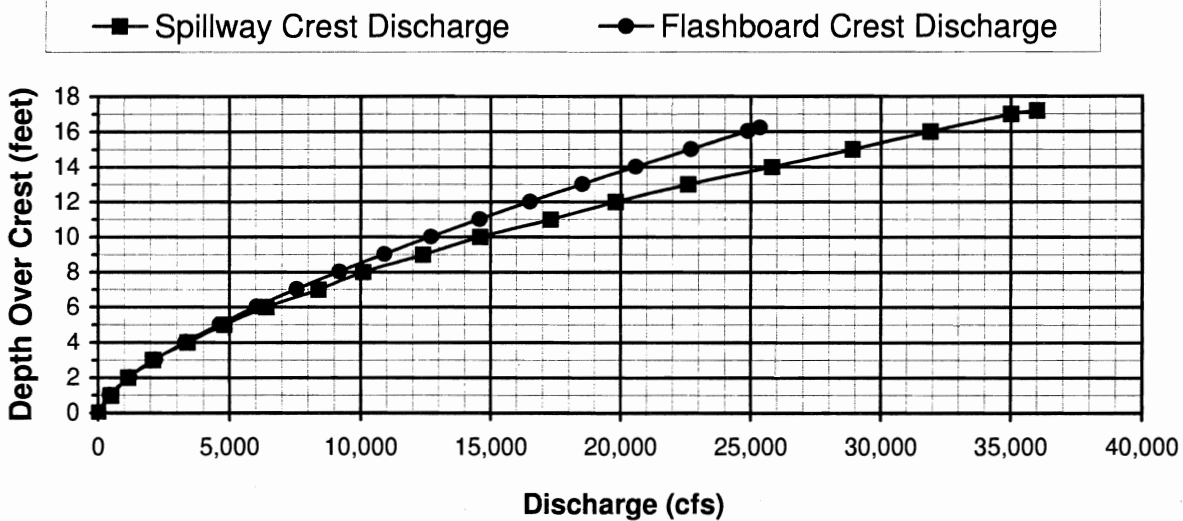
Spillway Crest Elevation 5,392.0 feet Storage 36,633 acre-feet

Dam Crest Elevation 5,409.2 feet Storage 56,355 acre-feet

**TABLE 4. SPILLWAY DISCHARGE**  
**RUBY RESERVOIR**

Elevation (feet)	Concrete Spillway Crest		Flashboard Crest	
	Depth Over Spillway (feet)	Discharge (cfs)	Depth Over Flashboard (feet)	Discharge (cfs)
5392	0	0		
5392.97	0.97	478	0	0
5393	1	500	0.03	2
5394	2	1,150	1.03	435
5395	3	2,100	2.03	1,204
5396	4	3,400	3.03	2,184
5397	5	4,800	4.03	3,333
5398	6	6,400	5.03	4,627
5399	7	8,400	6.03	6,041
5400	8	10,100	7.03	7,563
5401	9	12,400	8.03	9,196
5402	10	14,600	9.03	10,908
5403	11	17,300	10.03	12,698
5404	12	19,800	11.03	14,575
5405	13	22,600	12.03	16,508
5406	14	25,800	13.03	18,520
5407	15	28,900	14.03	20,581
5408	16	31,900	15.03	22,696
5409	17	35,000	16.03	24,870
5409.2	17.2	36,000	16.23	25,337

**RUBY SPILLWAY RATING CURVES**



Note: Data from the Corps of Engineers Phase 1 Inspection Report (1980).

**APPENDIX C**

**INSPECTION REPORT FORM**

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION  
DAM SAFETY INSPECTION REPORT

NAME OF DAM \_\_\_\_\_  
DATE INSPECTED \_\_\_\_\_

INVENTORY NO. \_\_\_\_\_  
HAZARD CATEGORY \_\_\_\_\_  
TYPE OF DAM \_\_\_\_\_  
YEAR BUILT \_\_\_\_\_

OWNER \_\_\_\_\_  
OPERATOR \_\_\_\_\_  
STREAM \_\_\_\_\_  
DRAINAGE AREA \_\_\_\_\_

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	
At spillway crest	_____	
At min. dam crest elevation	_____	

ITEM	YES	NO	REMARKS
------	-----	----	---------

**1. EMBANKMENT**

A. Crest -- Height=      Length=      Width=

(1) Any visual settlements?			
(2) Any misalignments?			
(3) Any cracking?			
(4) Any traffic damage?			
(5) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

**1. EMBANKMENT** (continued)

**B. Upstream Face -- Slope=**

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Is riprap protection adequate?			
(5) Any stone deterioration?			
(6) Any visual settlement, slumps, sloughing, depressions or bulges?			
(7) Adequate grass cover?			
(8) Debris on the dam face?			
(9) Other?			

**C. Downstream Face--Slope=**

(1) Any erosion?			
(2) Any longitudinal cracks?			
(3) Any transverse cracks?			
(4) Any visual settlement, slumps, sloughing, depressions or bulges?			
(5) Is the toe drain dry?			
(6) Are the relief wells flowing?			
(7) Any boils at the toe?			
(8) Any seepage areas?			
(9) Any traffic or animal damage?			
(10) Any burrowing animals?			
(11) Adequate grass cover?			
(12) Other?			

**D. Amount and Type of Vegetation on the Dam**

--

ITEM	YES	NO	REMARKS
------	-----	----	---------

## 2. ABUTMENT CONTACTS

A) Any erosion?			
B) Any visual differential movement?			
C) Any cracks?			
D) Any seepage present?			
E) Other?			

## 3. OUTLET WORKS

### A. Intake Structure -- Size=

(1) Any settlement?			
(2) Any tilting?			
(3) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(4) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(5) Metal appurtenances:			
a. Any corrosion present?			
b. Any breakage present?			
(6) Trash rack?			
a. Condition?			
b. Anchor system secure?			
(7) Other?			



ITEM	YES	NO	REMARKS
------	-----	----	---------

### 3. OUTLET WORKS (continued)

B. Conduit -- Type =

Size =

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Is the conduit metal?			
a. Any corrosion present?			
b. Protective coatings adequate?			
(4) Is the conduit misaligned?			
(5) Any calcium deposits?			
(6) Other?			

### C. Gates and Tower

(1) Gates:			
a. Size: Operating:	Emergency:		
b. Type: Operating:	Emergency:		
(2) Controls operational?			
(3) Controls lubricated?			
(4) Operational problems?			
(5) Leakage around gates?			
(6) Condition of gate seals?			
(7) Any cavitation damage? If so, describe?			
(8) Describe air vent-size and condition.			

ITEM	YES	NO	REMARKS
------	-----	----	---------

### 3. OUTLET WORKS (continued)

#### C. Gates and Tower (continued)

(9) Is there a jet pump?			
a. Is it operational?			
b. Leakage?			
(10) Is the tower dry? ____ wet?			
(11) Any seepage in the tower?			
(12) Condition of the tower?			
(13) Any safety problems?			
(14) Ladder in good condition?			
(15) Condition of the gatehouse?			
(16) Emergency plan completed for the dam?			
a. Posted in the gatehouse?			
(17) Other?			

#### D. Stilling Basin

(1) Do concrete surfaces show:			
a. Spalling?			
b. Cracking?			
c. Erosion?			
d. Exposed reinforcement?			
(2) Do joints show:			
a. Displacement or offset?			
b. Loss of joint material?			
c. Leakage?			
(3) Do energy dissipaters show:			
a. Signs of deterioration?			
b. Are they covered with debris?			
(4) Other?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

### 3. OUTLET WORKS (continued)

#### E. Downstream Channel

(1) Is the channel:			
a. Eroding or backcutting?			
b. Sloughing?			
c. Obstructed?			
(2) Is released water:			
a. Undercutting the outlet?			
b. Eroding the embankment?			
(3) Other?			

### 4. SPILLWAY

#### A. Description

(1) Location?			
(2) Type of Spillway?			
(3) Size of Spillway?			
(4) Spillway lining?			
(5) Is there a weir?			
(6) Is the spillway in good condition?			
(7) Any drains?			
a. Describe the condition of drains.			

#### B. Does spillway show:

(1) Any cracking concrete?			
(2) Any spalling concrete?			
(3) Any exposed reinforcement in the concrete?			
(4) Any erosion?			

ITEM	YES	NO	REMARKS
------	-----	----	---------

#### 4. SPILLWAY (continued)

##### 4. B. Does spillway show: (continued)

(5) Any slope sloughing?			
(6) Any obstructions?			
(7) Displacement or offset joints?			
(8) Loss of joint material?			
(9) Leakage at the joints?			
(10) Other?			

##### C. Do the energy dissipaters show:

(1) Signs of deterioration?			
(2) Any cracking?			
(3) Any spalling?			
(4) Any exposed reinforcement?			
(5) Are they covered with debris?			
(6) Other?			

##### D. Has release water:

(1) Eroded the embankment?			
(2) Undercut the outlet?			
(3) Eroded the downstream channel?			
(4) Other?			

##### E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)

ITEM	YES	NO	REMARKS
------	-----	----	---------

#### 5. RESERVOIR CONTROL

A) Recent upstream development?			
B) Recent downstream development?			
C) Slides in reservoir area?			
D) Change in reservoir operation?			
E) Large impoundment upstream?			
F) Any debris in the reservoir?			
G) Other?			

#### 6. INSTRUMENTATION

A) List type(s) of instrumentation:			
B) In good condition?			
C) Read periodically?			
D) Is data available?			
E) Include all data gathered since last report.			

#### 7. DOWNSTREAM CONDITION

A. Downstream Land Use.

--

This dam was inspected by:

**Additional comments and recommendations.**



**APPENDIX D**

**O&M MANUAL DISTRIBUTION LIST**

## O&M MANUAL DISTRICUTION LIST

### RUBY DAM

	<u>Number Of Copies</u>
1. State Water Project Bureau	7
Glen McDonald	
Greg Ames	
Art Taylor (2)	
Bob Arrington	
Bob Clark	
Delores Eustice	
2. DNRC Information Services Section	1
3. DNRC Bozeman Regional Office	1
Scott Compton	
4. DNRC Dam Safety	1
5. Water Users	4
Dan Doornbos – President	
Jim Anderson – Vice President	
Neil Todd – Secretary/Dam Operator/Ditchrider	
Copy for Gatehouse	
6. State Library – Attn: Roberta Gebhardt	4
7. Extra	2
Total	20



## **APPENDIX E**

### **MONITORING WELL LOGS**

**(NOTE: The monitoring well logs have not been prepared as of this printing. The well logs will be added in the future when they are prepared.)**

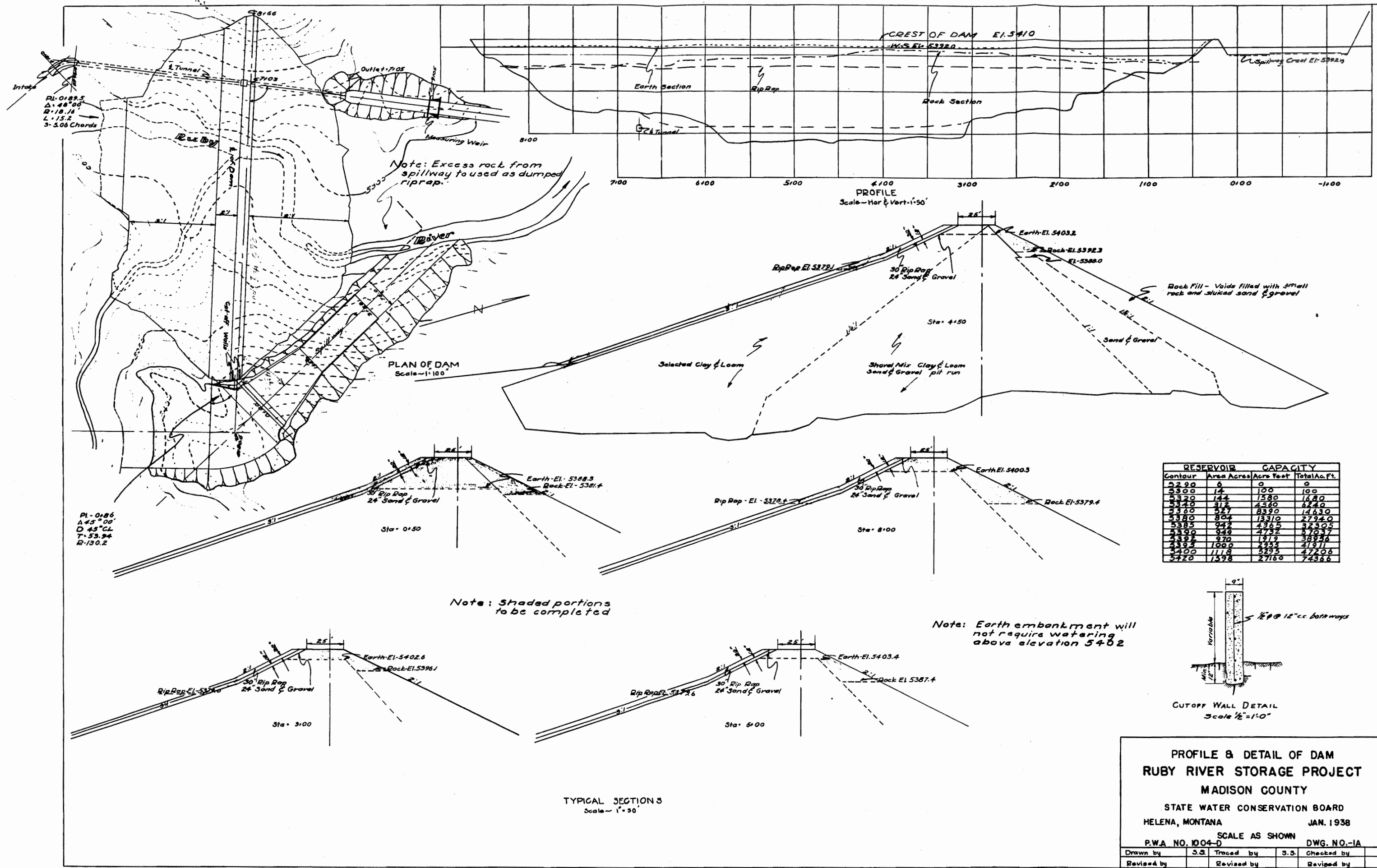


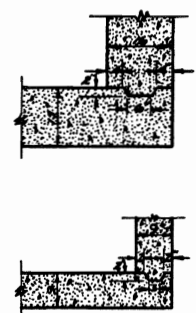
## **APPENDIX F**

### **PROJECT DRAWINGS**

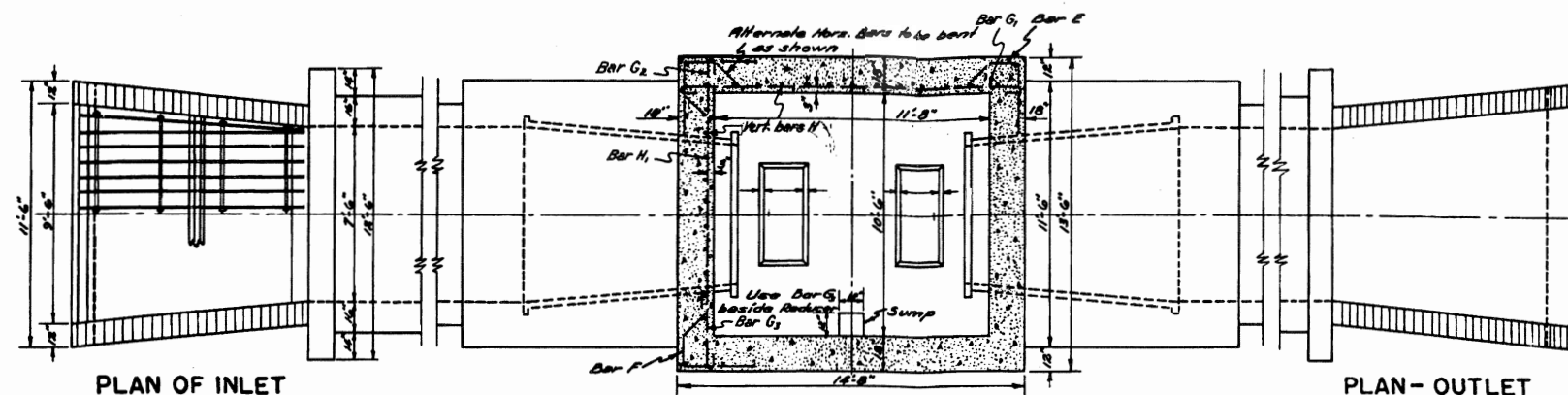
**(NOTE: These reduced project drawings are design drawings and not "As Builts". These drawing should be used for reference only. The SWPB has the full size project drawings.)**







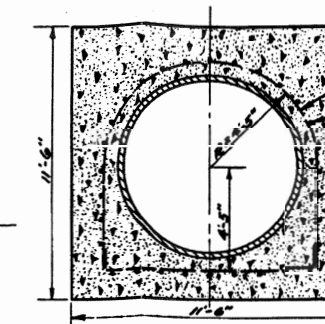
CONSTRUCTION JOINTS  
SCALE: 1/2" = 1'



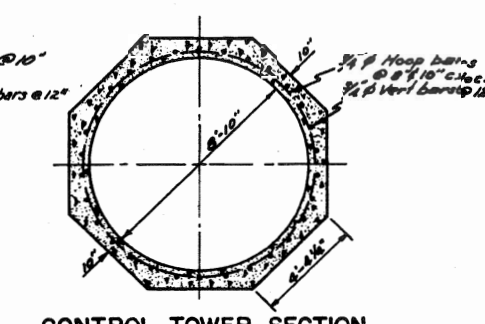
PLAN OF INLET  
SCALE: 1/4" = 1'

PLAN-OUTLET  
SCALE: 1/4" = 1'

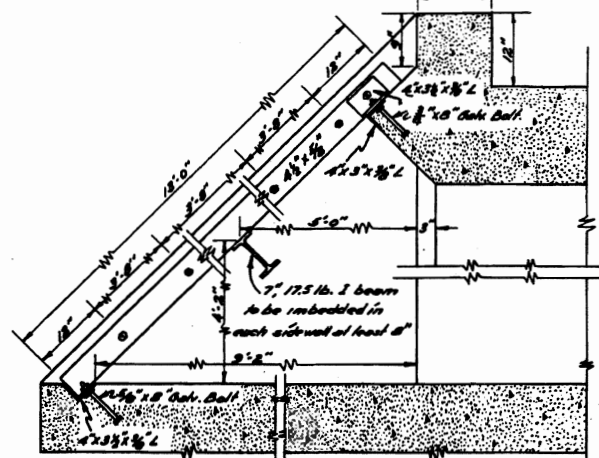
CONTROL CHAMBER  
SECTION A-A  
1/4" = 1'



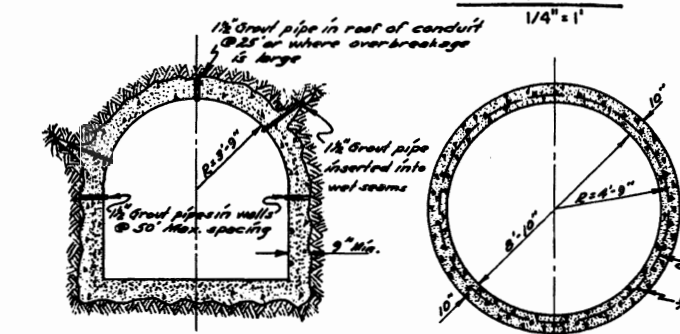
SECTION C-C  
SCALE: 1/4" = 1'



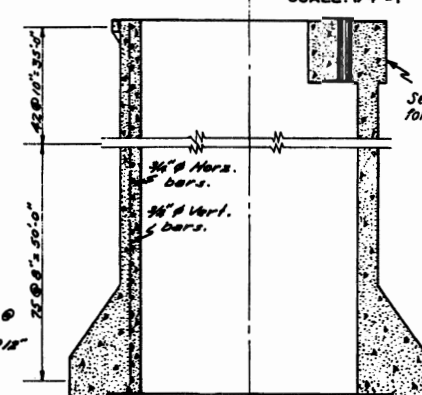
CONTROL TOWER SECTION  
IN FILL  
SCALE: 1/4" = 1'



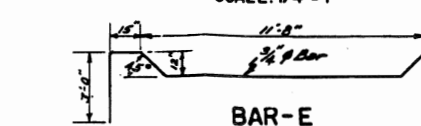
TRASH RACK DETAIL  
SCALE: 3/4" = 1'



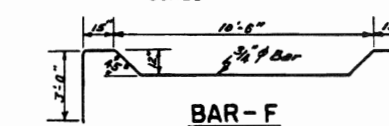
TUNNEL CONDUIT SECTION  
SHOWING TYPICAL SECTION WHERE  
WET SEAMS ARE ENCOUNTERED.  
SCALE: 1/4" = 1'



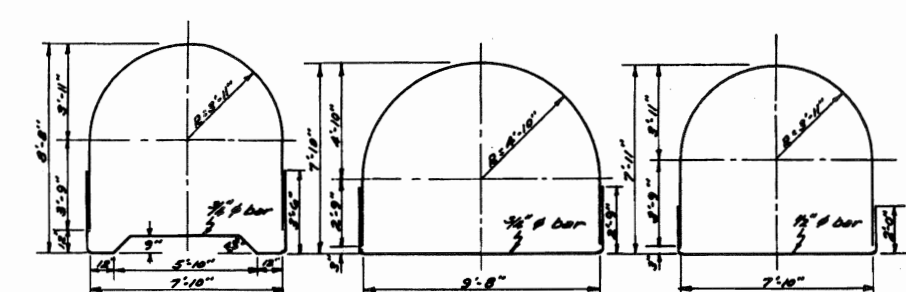
CONTROL TOWER SECTIONAL ELEV.  
SCALE: 1/4" = 1'



BAR-E



BAR-F

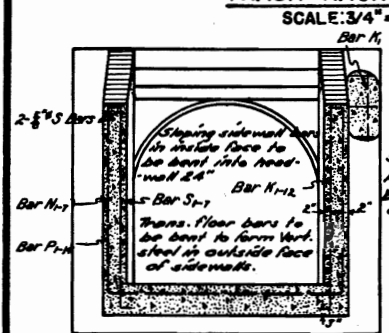


BAR-A

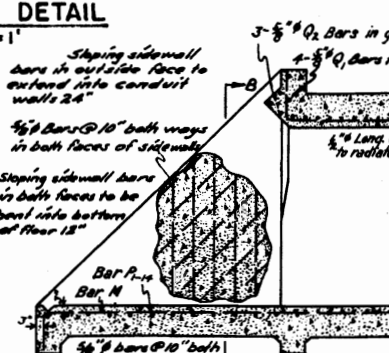
BAR-B

BAR-C

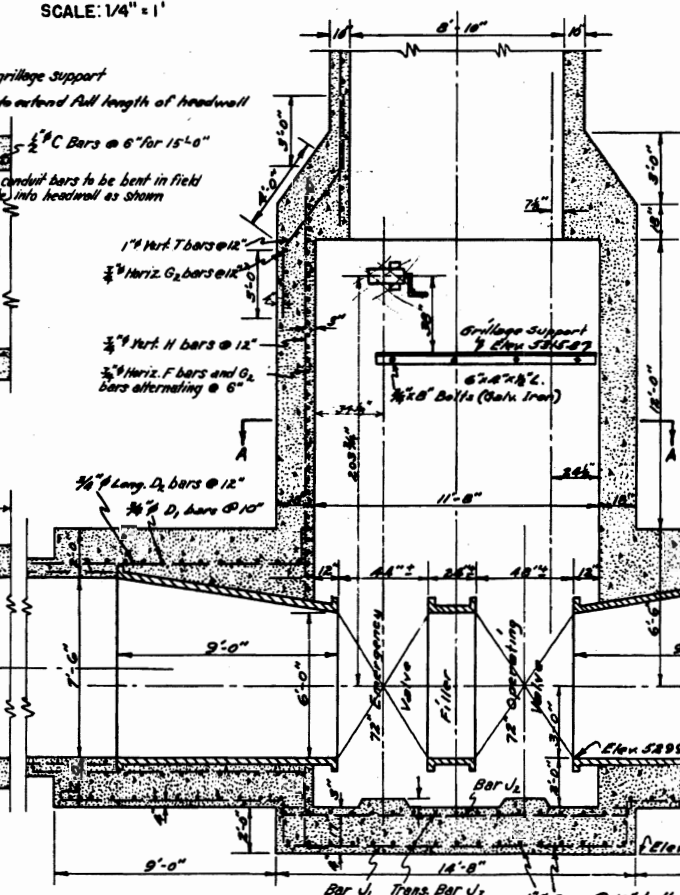
Note:  
In the present design there will be no open conduit  
section so Bar A and Bar B will be omitted.



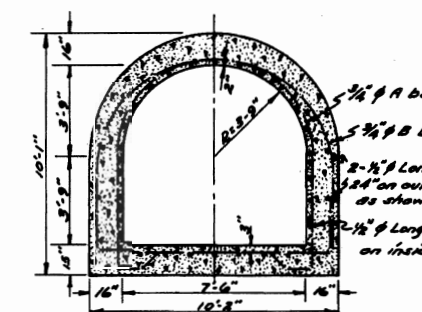
SECTION B-B  
SCALE: 1/4" = 1'



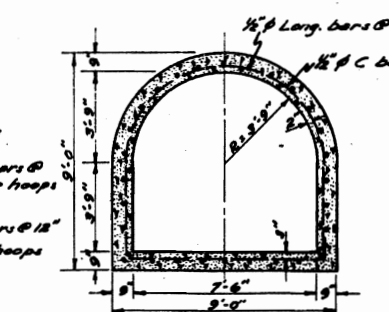
SIDE ELEVATION-INLET  
SCALE: 1/4" = 1'



SECTIONAL ELEVATION-CONTROL CHAMBER  
SCALE: 1/4" = 1'

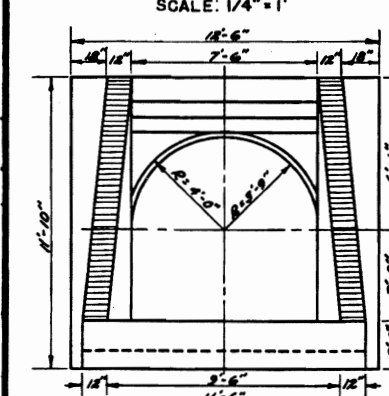


OPEN CONDUIT SECT.  
SCALE: 1/4" = 1'

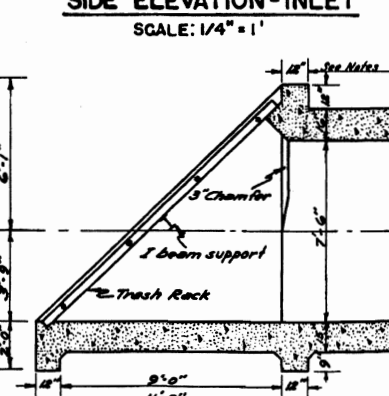


TUNNEL CONDUIT SECT.  
SCALE: 1/4" = 1'

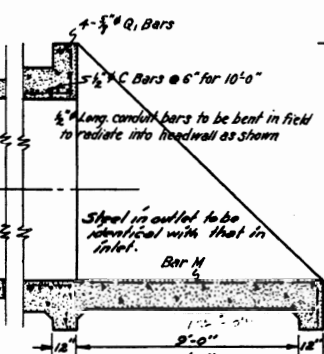
**GENERAL NOTES**  
All concrete edges to be chamfered 1/4".  
Reinforcing steel to be placed a minimum distance of  
2" from surface of concrete.  
Reinforcing steel with hooked ends to be bent in a  
hook of minimum of 5 diameters.  
Reinforcing steel to lap 40 diameters unless otherwise  
shown.  
Side walls of inlet and outlet structures to be cast against  
rock.  
Conduit section with 16" walls to extend from headwall of  
inlet structure a distance of 10' into tunnel and  
from headwall of outlet structure a distance of 10' into  
tunnel.  
Bars E and bars F to be placed in alternate tiers in  
control chamber walls.  
If operating stem of emergency valve is carried to top  
of lower, grille support as shown in SECTIONAL ELEV-  
ATION-CONTROL CHAMBER will be omitted.  
Stagger laps in control tower hoop bars.  
A set of D bars will be placed in the same tier  
with a set of E bars and a set of F bars will  
be placed in the same tier with a set of D bars.



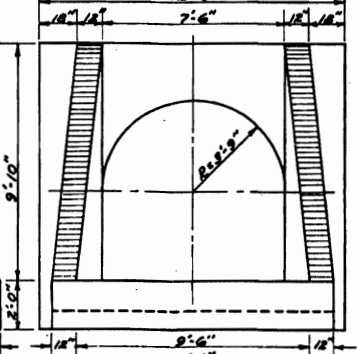
END ELEVATION-INLET  
SCALE: 1/4" = 1'



SIDE ELEVATION-OUTLET  
SCALE: 1/4" = 1'



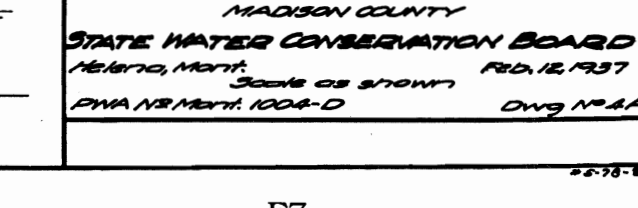
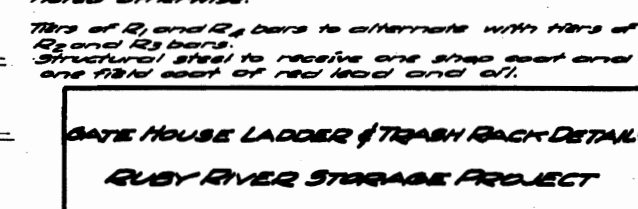
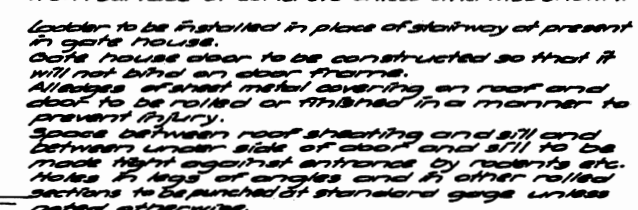
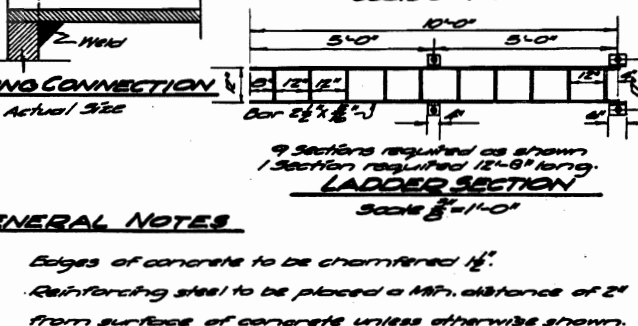
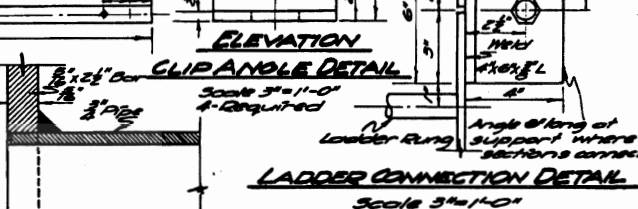
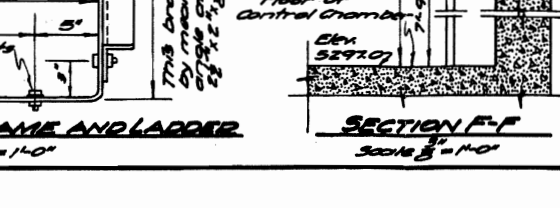
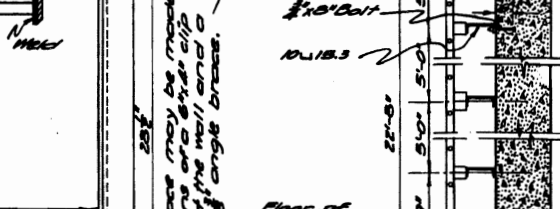
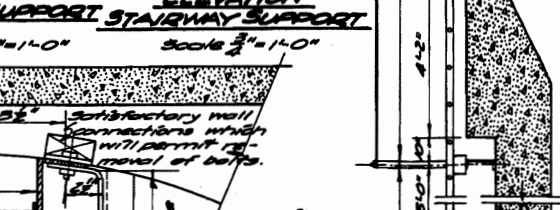
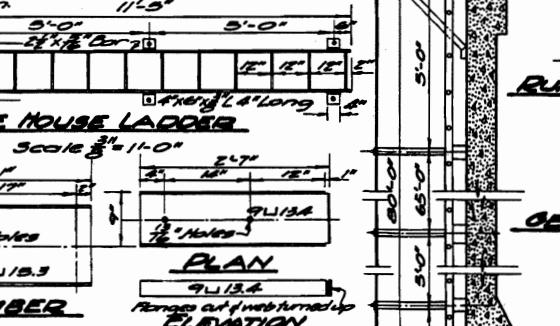
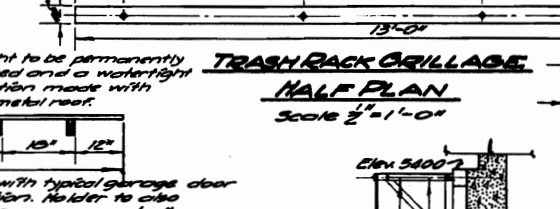
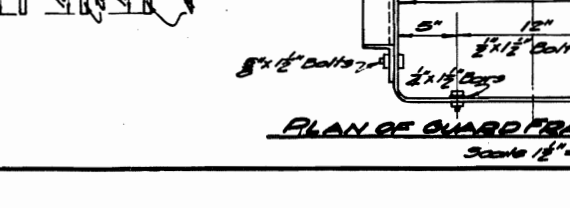
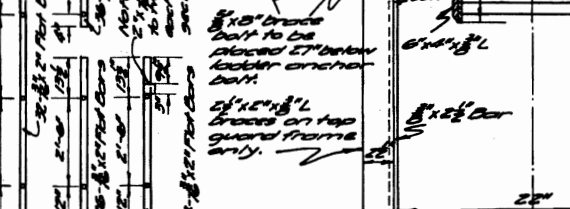
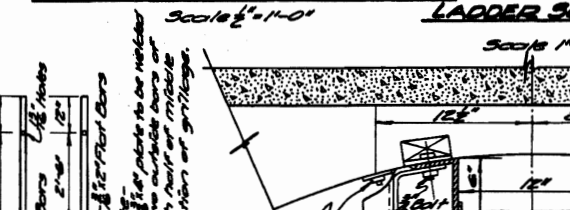
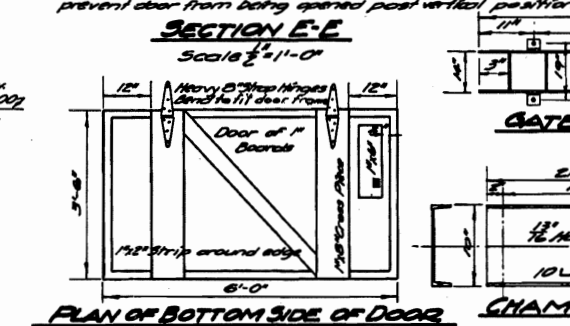
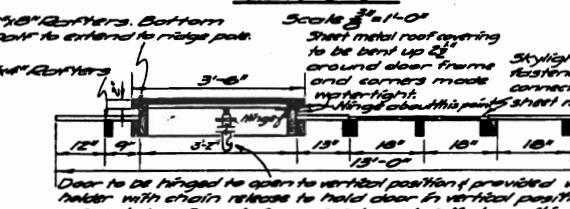
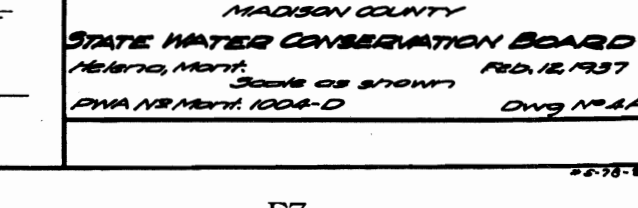
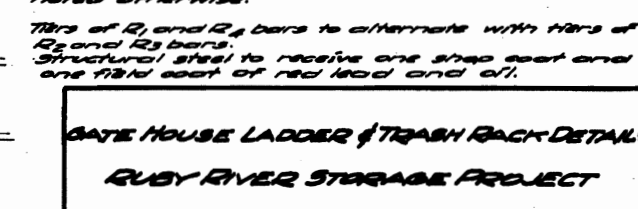
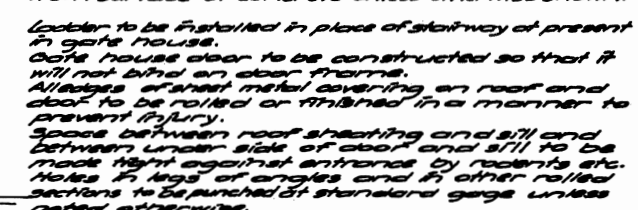
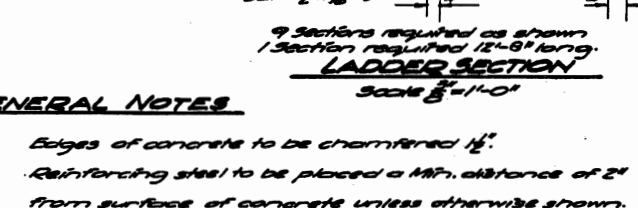
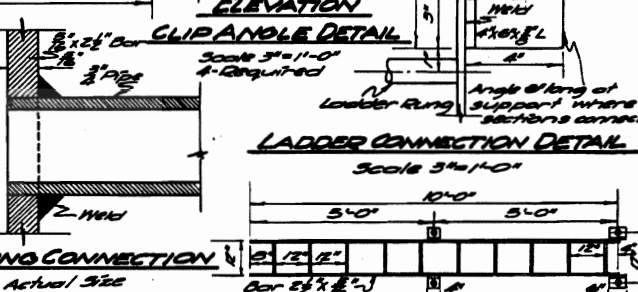
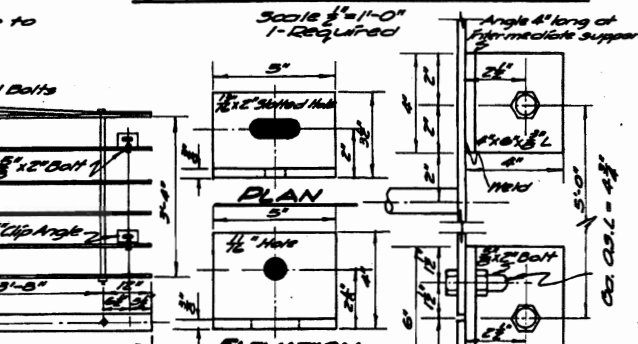
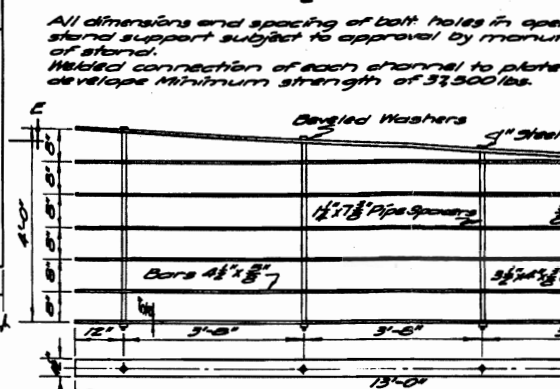
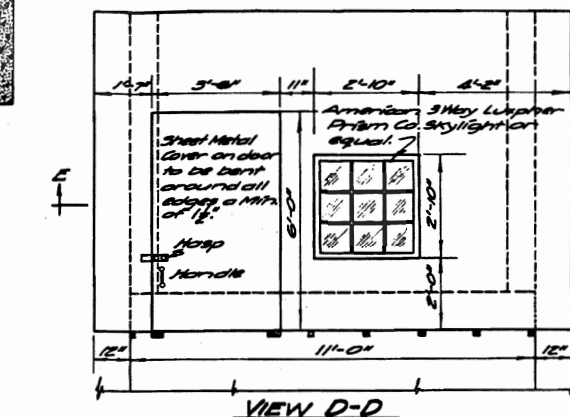
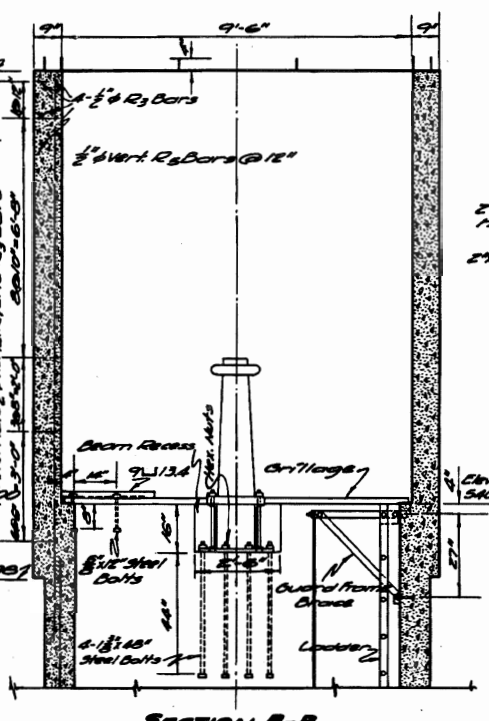
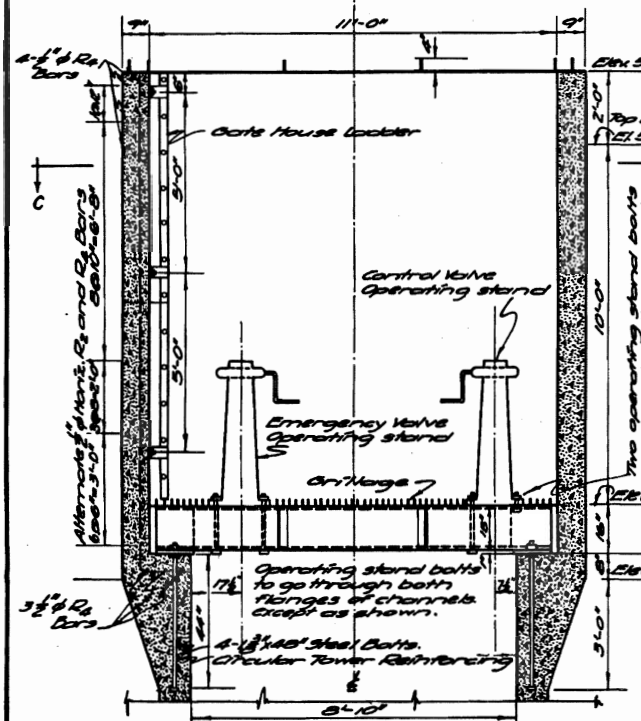
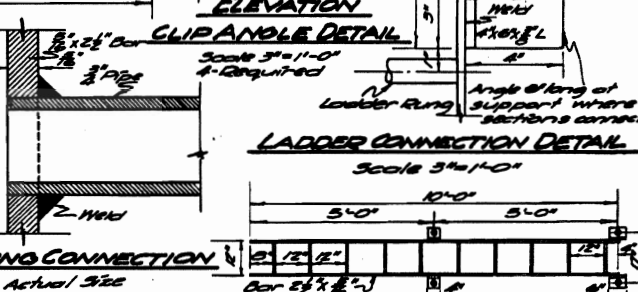
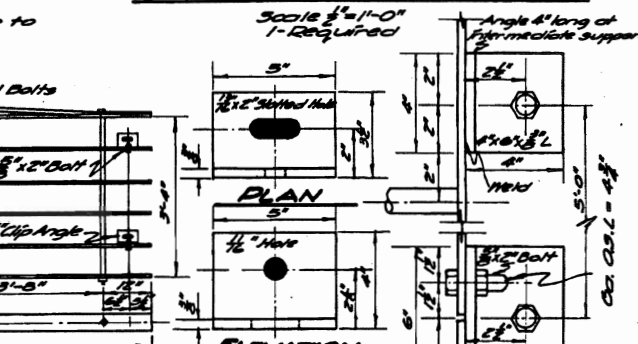
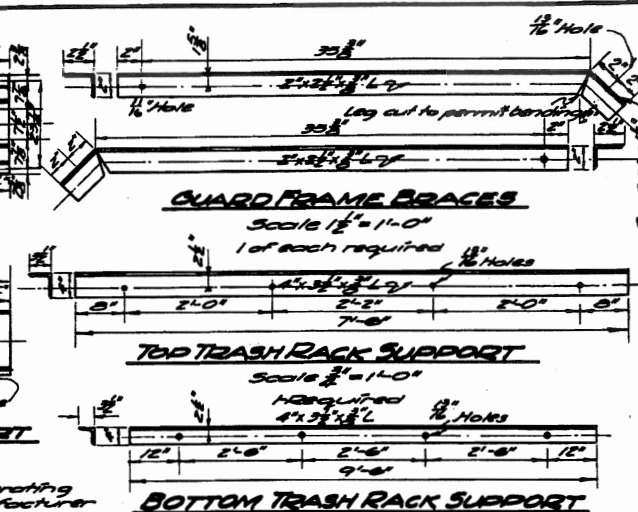
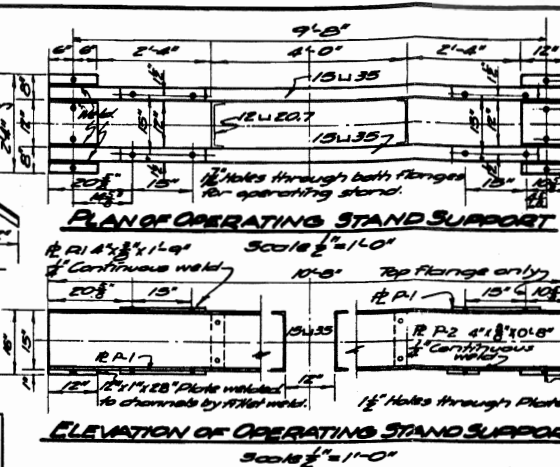
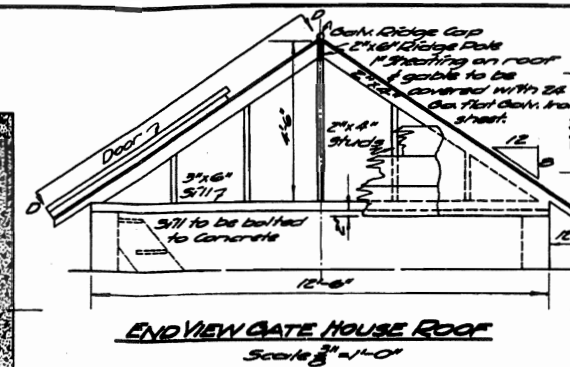
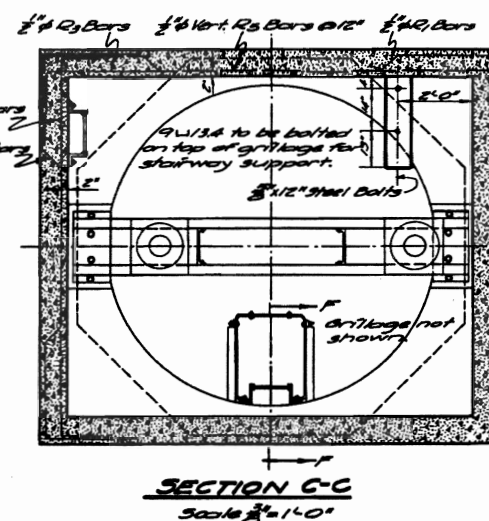
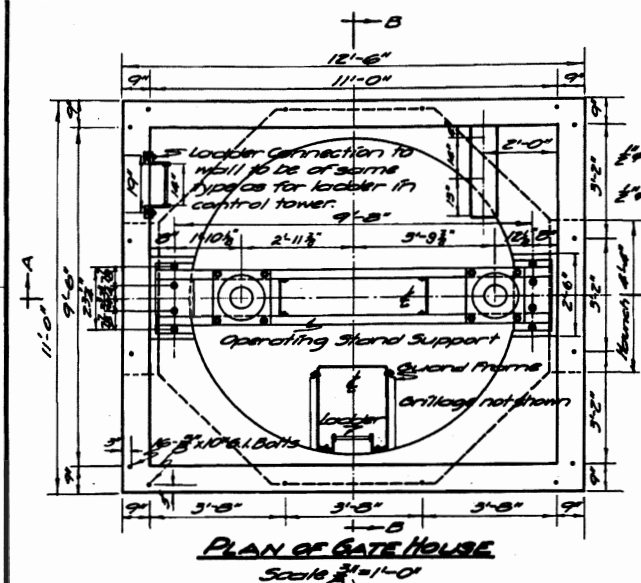
SIDE ELEVATION-OUTLET  
SCALE: 1/4" = 1'

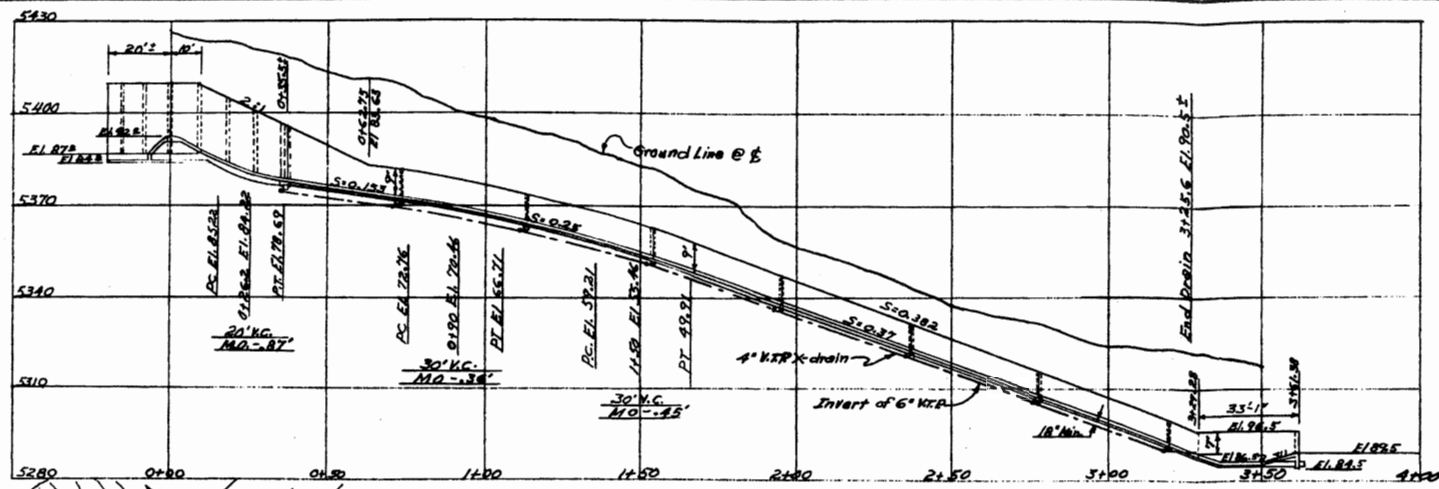


END ELEVATION-OUTLET  
SCALE: 1/4" = 1'

**CONTROL WORKS**  
DETAILS OF OUTLET STRUCTURE  
**RUBY RIVER STORAGE PROJECT**  
MADISON COUNTY  
STATE WATER CONSERVATION BOARD  
HELENA, MONT. NOV. 21, 1936  
SCALE AS SHOWN  
P.W.A. NO. 1004-D DRAWING NO. 3







PROFILE  
Scale 1"=30' Horiz. & Vert.

Floor Thickness  
Sta. 0+03.75-0+35.5 = 9"  
Sta. 0+35.5-3+28.28 = 6"  
Sta. 3+28.28-3+61.38 = 9"

Note: Where 6" floor is used 3" overbreak will be allowed in excavation & concrete

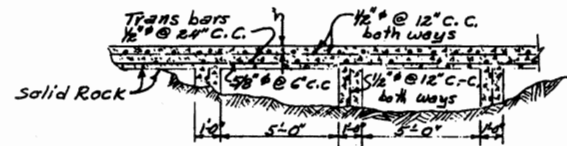
SPILLWAY CREST DATA

Station	Elevation
-0+02.8	5391.43
-0+02.1	91.74
-0+01.4	91.92
-0+00.7	91.99
0+00.0	92.00
0+00.7	91.96
0+01.4	91.86
0+02.1	91.74
0+02.8	91.55
0+03.5	91.36
0+04.2	91.09
0+04.9	90.81
0+05.6	90.52
0+06.3	90.18
0+07.0	89.83

SPILLWAY HYDRAULICS

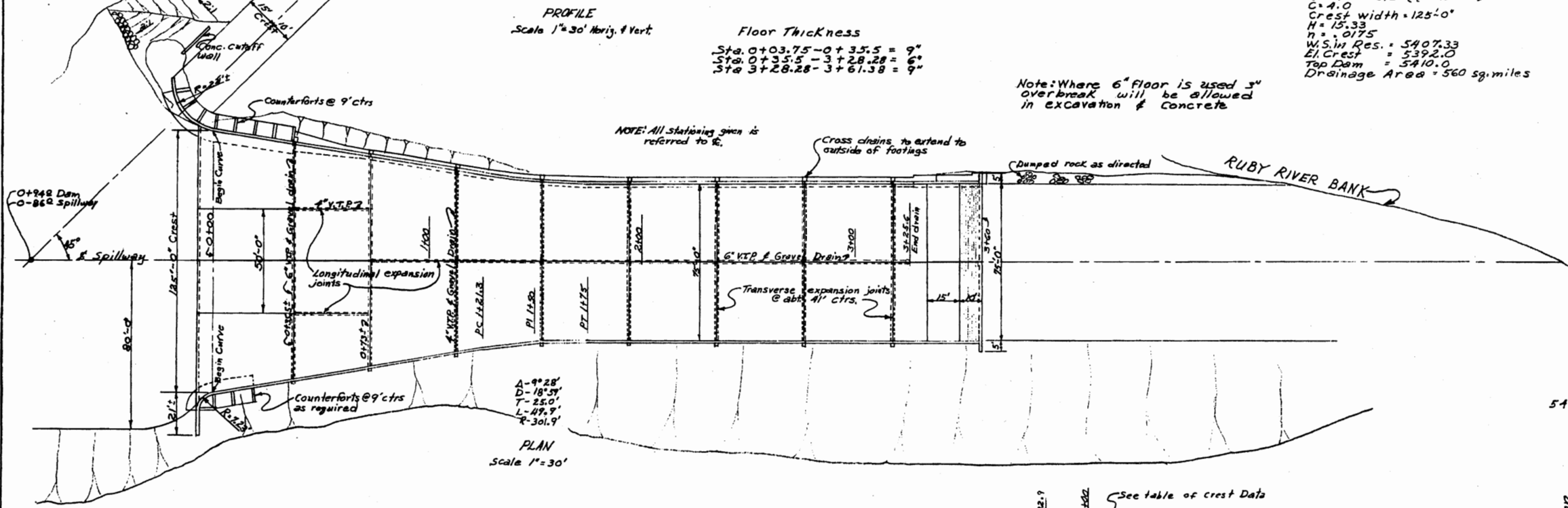
Q=30,000 cfs. (Q=CLH 3/4)  
C=4.0  
Crest width=125'-0"  
H=15.33  
n=.0175  
W.S. in Res.=5407.33  
El. Crest=5392.0  
Top Dam=5410.0  
Drainage Area=560 sq. miles

SPILLWAY DATA			
Station	Point	Elevation	Width
		Top Floor	Top Wall
0+00.0	Crest	5392.2	5410.0
0+00.0		89.83	5410.0
0+10.0			5410.0
0+16.2	Gr. P.C.	85.22	120.26
0+26.2	Gr. P.I.	81.09	116.26
0+36.2	Gr. P.T.	78.69	112.93
0+40		78.12	111.56
0+50		76.59	108.34
0+62.28			83.63
0+75	Gr. P.C.	72.76	81.76
0+90	Gr. P.I.	70.10	79.10
1+05	Gr. P.T.	66.71	75.71
1+21.3	P.C.		
1+35	Gr. P.C.	59.21	68.21
1+50	Gr. P.I.	55.01	64.01
1+65	Gr. P.T.	49.91	58.91
1+75	P.T.		
2+00		36.96	45.52
2+50		18.46	26.41
3+00		99.96	
3+28.28			96.5
3+36.38		86.50	96.5
3+51.38		86.50	96.5
3+60.38		89.50	96.5
3+61.38		89.50	96.50

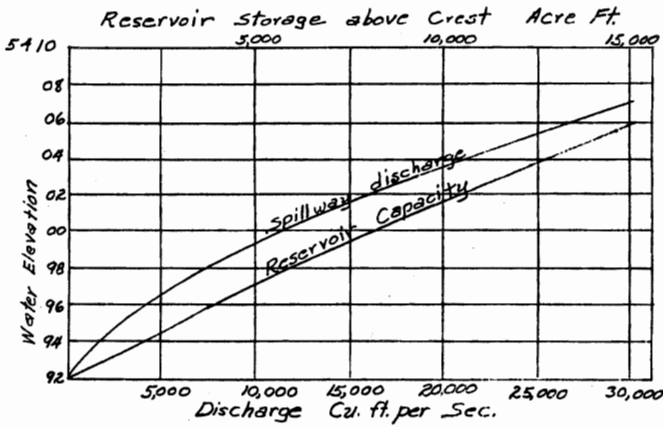


SECTION OF FLOOR  
Scale 1/4"=1'-0"

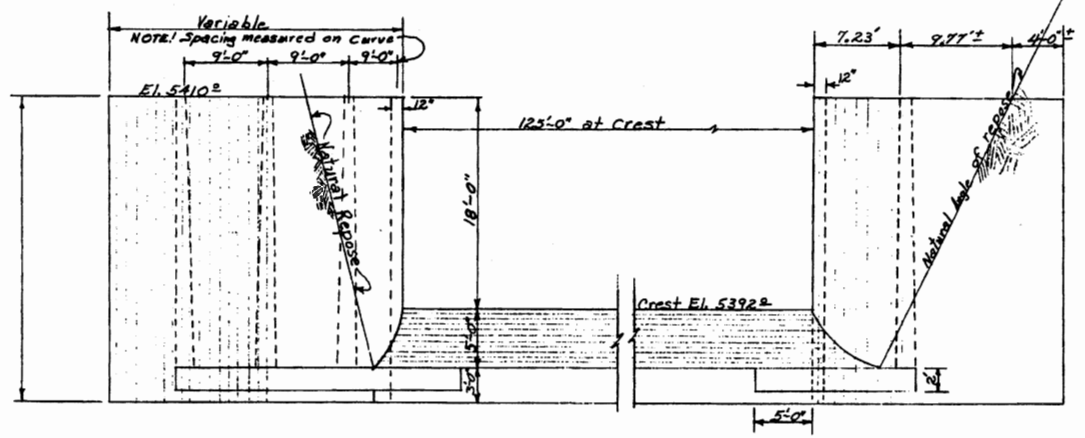
Note: To be used when spillway floor is not on solid rock



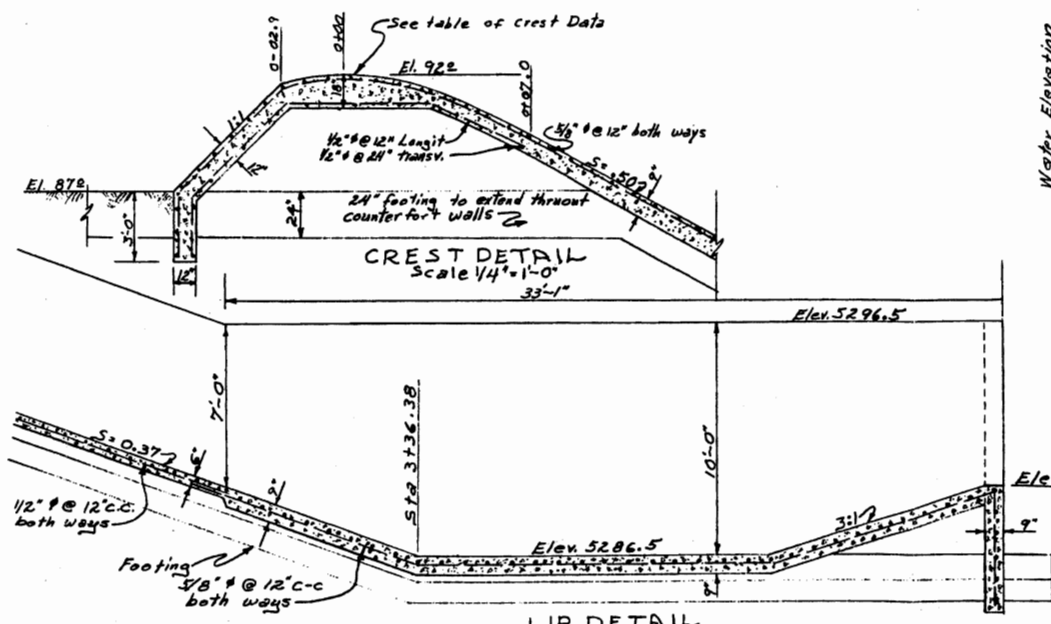
PLAN  
Scale 1"=30'



Curves Showing Spillway Discharge and Reservoir Capacity Above Spillway Crest



UPSTREAM ELEVATION  
Scale 1/8"=1'-0"



LIP DETAIL  
Scale 1/4"=1'-0"

PLAN AND PROFILE OF SPILLWAY  
RUBY RIVER STORAGE PROJECT  
MADISON COUNTY

STATE WATER CONSERVATION BOARD  
HELENA MONTANA  
R.W.A. NO. 1004-D

FEB. 8 1938  
Dwg. No. 5-B

Drawn By	Typed By	Checked By
Revised By	Revised By	Revised By